JUNE 30, 1958 PRICE 50 CENTS

Product Engineering

RESEARCH and DEVELOPMENT news edition

McGRAW-HILL MAGAZINE OF DESIGN RESEARCH AND DEVELOPMENT

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EDUCATION: US vs USSR

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BRITISH DESIGN

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LOST in a maze of materials...

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E B POWER GS 1
UNIVERSITY MICROFILMS 1
313 N 1 ST
ANN ARBOR MICH A

A NEW MATERIAL TO BRIGHTEN UP YOUR PRODUCT

Color helps sell these new Sunbeam electric fry pans and other Sunbeam Corporation appliances.

Where do you want to put the selling power of *color* to work in your product?

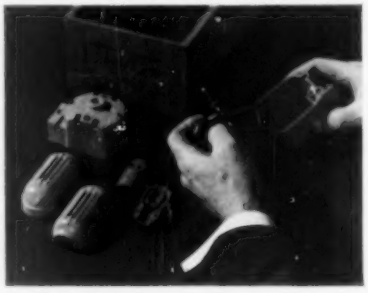
Now you can get rigid, strong parts like these *in a whole spectrum of opaque, light-fast colors.* How? With a new, amazingly durable plastic molding material—*Durez polyester.*

These parts combine rugged strength with other qualities you'll find in no other color plastic. Their electrical properties are outstanding. They're inherently fire-resistant—meet Underwriters' requirements for appliances.

You can use Durez polyester in many places where you can't use other plastics, because *molded parts show virtually no change in dimensions after molding!*

Your molder can get this new plastic now in a variety of standard colors. It comes in a dry granular form and is easily molded on standard presses with compression or transfer molds.

If you'd like to brighten up your product with strong, dimensionally stable parts like these, ask us for illustrated Bulletin 200. It shows how leading manufacturers are using Durez polyester to spur sales of consumer products. Write DUREZ PLASTICS DIVISION, Hooker Electrochemical Company, 1506 Walck Road, North Tonawanda, New York.



Solves shrinkage problem! These parts for Singer Sewing Machine Co., molded from Durez polyesters, retain their shape better than any other color plastic. Parts fit together better for faster assembly, fewer rejects.

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HOW MOSCOW DESIGNS
coming July 14

Your next R&D News Edition will be devoted to one subject only—design engineering in the Soviet Union. Our editor spent two weeks in and around Moscow, visiting the largest design institute and the largest auto plant, previewing the huge Industrial Exhibition, checking the Polytechnical Museum and the stores, interviewing members of the Academy of Sciences, engineers, editors, officials. From these varied sources, he has assembled a detailed technical report on how USSR research, development and design are done. We give it to you in one compact, easy-reading package on July 14. Read about:

Moscow—the city, its people, how they live

What Industry and People Can Buy

What Is New in Equipment

How Equipment is Developed

Latest Automated Designs

How Factories Do Their Own Redesign

The Soviet Engineer and His Rewards

If You Visit the USSR on Business

All in one on-the-scene report
in your July 14 R&D News Edition
Don't Miss It

coming next week . . .

the DESIGN edition for July 7

FEATURING

- **Bellwether with wings**

  Plant-to-plant staff survey in aircraft industry uncovers 26 new areas of development in materials and processes.

- **How to predict gear train efficiency**

  New formulas and test data to figure power lost in sliding contact.

- **Glass and ceramic fibers**

  Thread-like materials to withstand high temperatures.

- **Compressive strength of thin-wall cylinders**

  Axially loaded cylinders with and without internal pressure.

- **Britain's new variable-speed motor**

  Induction motor works on a constant frequency without sliprings or commutators.

- **Stresses in adhesive joints**

  Six basic load-bearing joints and how to calculate stress concentrations in each.

Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN, RESEARCH AND DEVELOPMENT

R and D Research and Development news edition

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Product Engineering ....SIDELIGHTS

RESEARCH and DEVELOPMENT news edition

● **When it comes to luxury** the British really can't be beat. Their designs are conservative for the most part (p. 22) but the fantastic attention to detail often drives the price right through the sky. In a recent advertisement, for example, Rolls-Royce describes its radiator design: ". . . it has never changed, except that when Sir Henry Royce died in 1933 the monogram RR was changed from red to black." Further, "The Bentley is made by Rolls-Royce. Except for the radiators, they are identical motor cars. The Bentley costs $300 less, because its radiator is simpler to make." A 1958 Cadillac radiator lists for $77.65.

● **Dr. Thomas Gold of Harvard,** a top astrophysicist, gives us this disturbing statistic. "Over 90% of all scientists who ever lived are living now. They are just as clever on the average as the men who preceded them and they are better trained. I think we can expect discoveries as far-reaching and important as those of electricity and atomic energy, or the invention of the airplane and the radio, all in the next half-century."

● **The other day we read** of a study of the Soviet literature on engineering education. It seems Russian professors are just as critical of their entering freshmen as ours are. "Inadequately grounded in mathematics and physics . . . trouble with the simplest problems . . ." they are quoted. Perhaps the whole subject of an "education race" is meaningless (p. 24) but we have at least derived another of Finagle's Laws: No matter how convincing an expert may be, there is always someone holding the opposite point of view, with just as convincing proof to the contrary.

● **For years we've been admiring** the verbal acrobatics of our more literary scientists. They gather at conferences, tug thoughtfully on their Van Dykes and entertain each other with breezy little talks on *Antineutrino Disintegration of the Deuteron* or *Heisenberg Operators in a Lagrangian Formalism.* But when we read the program of the Society of Automotive Engineers' Spring powwow in Atlantic City (p. 17) we got the surprise of our lives. Instead of a jaunty *Spectrum Analysis of Noise in Desmodromic Valve Trains* there's a scholarly treatise assaying the advantages of *Station Wagon Living and Family Fun.* Another engineer questions, *Knock, Knock—Spark Knock, Wild Ping or Rumble?* Our favorite, now and forever, *If You Squeeze Them, Must They Scream?*

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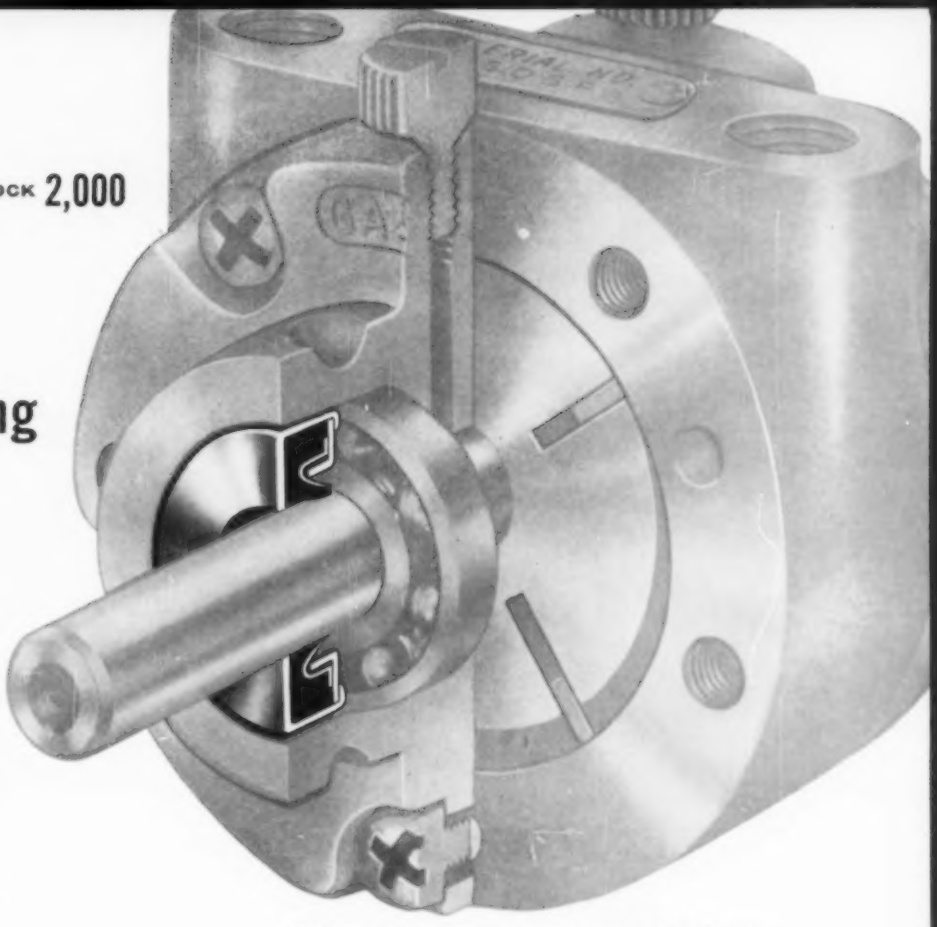
MORE ABOUT THE GARLOCK **2,000**

Standardizing on Garlock KLOZURE* Oil Seals Pays Off for Gast



Model 51 Garlock KLOZURE protects bearing on Gast Air Motor made by Gast Manufacturing Corp., Benton Harbor, Mich.

Air motors require a long-life seal which will prevent leakage without creating excessive friction. That's one reason why Gast Mfg. Corp. use Garlock KLOZURE Oil Seals on both their Air Motors and Air Pumps. These products operate under pressures to 90 and 30 psi respectively, and at shaft speeds from 1000 to 5000 rpm.

Gast engineers report excellent results with Garlock Seals.—"They outlast some other parts of our products and are easily and economically replaced during major overhauls." Gast has standardized on Garlock KLOZURES for over 25 years—They like the compact design of KLOZURES, the wide availability of replacements, and the broad choice of sizes.

You can give *your* products the "seal of quality" too—specify Garlock KLOZURE Oil Seals . . . they are part of the famous Garlock 2,000 . . . two thousand different styles of packings, gaskets, and seals to meet all your needs. Consult your local Garlock Representative or write for KLOZURE Catalog 20. Other Garlock products are described in Sweet's Product Design File.

*Registered Trademark

Other General Purpose KLOZURES

Model 53—for normal to high speeds

Model 71B—for large shafts in normal to high speed service

Model 91B—for small shafts in normal to high speed service

Model 65—for normal to high speeds

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Drilling mud, containing sand and rock particles, looks like this as it flows from a well hole. It is "freshened up" for re-use in a cleaning machine equipped with a wear-resisting Monel alloy screen. *Photo courtesy Standard Oil Company, (New Jersey).*

It's murder on most metals

when mud goes to the cleaners

The idea of putting mud through a cleaning process may seem fantastic. But that's exactly what they do in the oilfields.

Drillers use special chemically treated mud to cool high-speed bits, and to bring up loose sand and rock particles.

That sand-rock-mud mixture is a murderous combination, an abrasive compound that no one recommends for continued use with expensive equipment.

So into a cleaning machine goes the mud! That's easier – and cheaper – than getting new mud. And just as good. All those bits of sharp and destructive rock are trapped inside a revolving cylinder made of Monel* nickel-copper alloy screen.

Monel alloy has the strength and toughness needed to resist this wear and abrasion. It also withstands corrosion by the chemicals in the mud, and the acid used in cleaning the machine. It's the kind of metal that takes problem jobs in stride.

Do you have a problem job, too? Write for a copy of "Standard Alloys." Contains answers to problems of corrosion, abrasion, high temperatures, fatigue.

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American...

DEVELOPMENTS TO WATCH...

Inflate tires with nitrogen . . .

. . . suggests Goodyear Tire & Rubber if you want to protect them from radiation damage, and perhaps also from other deteriorating factors.

Goodyear has been studying tire performance under extreme conditions with a view to providing new types for many special vehicles that now have requirements far above those of the passenger automobile.

Besides trying a variety of constructions and inflating gases, Goodyear tested several different configurations, among them, new low-profile types. These, the company reports, "have already passed qualification tests at 250 mph," and are "practically standard" for speeds in excess of 200 mph.

Research has a good way to go, though. Commercial aircraft now being built have landing speeds of 200 mph, requiring 21,300-lb load rating at 385-psi air pressure or more; and landing speeds in the 400-mph range are expected by 1960.

Glass fiber tapes for electrical insulation . . .

. . . developed by the Industrial Div. of Facile Corp., Paterson 4, N. J., include a new high-strength, all-glass material, and a plastic-backed glass-fiber mat.

The all-glass tape is made by reinforcing microfiber glass paper with strands of glass to produce a high-strength material that should stand temperatures at least to 600 F. This material is being tested for use as electrical insulation on dry-type transformers and as a wrapping for wire and cable. It has nonelectrical application possibilities as well, but these are still "classified."

The other material is limited to about 300 F by the plastic backing (a polyester film), but might well serve for short periods at higher temperatures. This material, too, is being evaluated for wire, cable and motor applications.

New types of closures . . .

. . . incorporate interesting locking principles that may generate new ideas for capping hydraulic and fuel lines and air vents; and providing loss-proof, tamper-proof, removable covers for instrument openings.

From France, for instance, come two new "captive" closures:

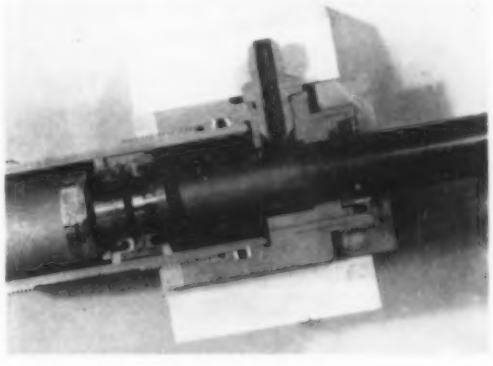
One is a tamper-proof snap cap, molded of polyethylene in one piece, but so designed that it converts into a permanent collar and hinged cap when a central tear-off strip is removed.

The other is a controlled dispenser of the screw-cap type. It has a movable, finned central element so it can be opened and closed at will; but, once installed, the unit cannot be removed.

Wheaton Plastics, Millville, N. J., has the exclusive US license for both closures. It plans to mold and sell them; may also license other companies.

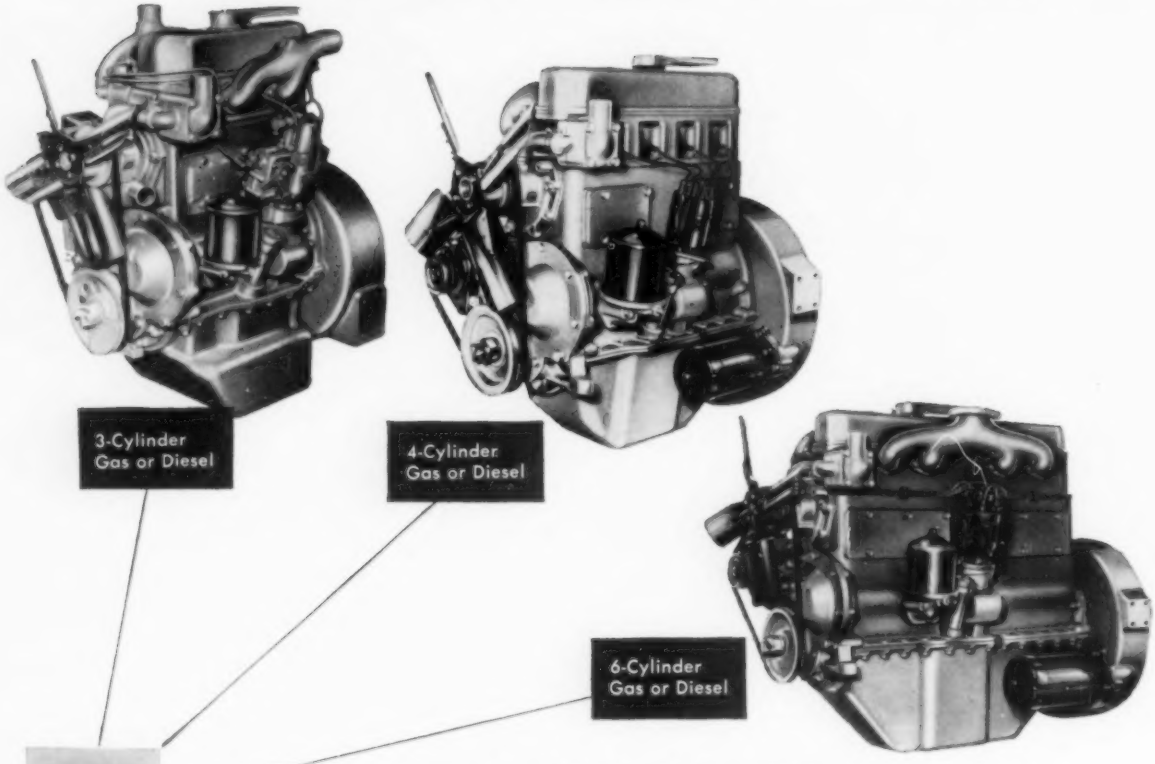
Metallic seal for use to 750 F . . .

. . . at pressures of 4,000 psi or more, has been developed by North American Aviation, Inc., Los Angeles 45. NAA engineers originally were seeking a better seal for aircraft and missile hydraulic systems, but now believe the unit may have a number of applications on various types of processing equipment. A patent application has been filed.



Positive dynamic and static sealing can be achieved with this design, North American Aviation says. It's for extreme-temperature use. —ARG

You can power your whole line with HERCULES engines



and get 18 HP ratings with 3 basic engine sizes

With three bore sizes in 3, 4, and 6 cylinder models, Hercules new DD diesel and GO gasoline (or LPG) engines offer 18 horsepower ratings from which to choose your power.

Diesel, gasoline and LPG-engines in the same number of cylinders have complete mounting interchangeability for "production-line" selection of power plant.

Your customers will welcome the simplified maintenance built into every Hercules DD and GO engine, too. Many spare parts will serve both 3-cylinder gasoline and 6-cylinder diesel engines—and everything between! There's an illustrated folder which demonstrates this parts interchangeability that's yours for the asking.

If you'd like more information on specific engine selections for your equipment line, call the Hercules representative near you or write to Hercules Motors Corporation, Canton 2, Ohio.

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DEVELOPMENTS TO WATCH...

Congress will give President Eisenhower most, ...

but not all, the power he wants to reorganize the military. The legislators are standing firm against strong White House pressure for complete freedom to juggle the military structure. The House of Representatives has approved 16 of the 19 points the Administration asked for.

What the Congressmen won't grant is: power to strip the individual services of the right to go to Congress "on their own initiative"; more subordination of each service to the Secretary of Defense; and, Presidential power to alter traditional service functions without Congressional approval.

One of the most important measures approved by the House calls for the establishment of a new director of research and engineering who would direct all Department of Defense R & D with full power to write contracts. This would be the most powerful research office yet created in the Pentagon. It would override the Advanced Research Projects Agency in authority.

The Senate is now tackling the military reorganization bill. But, indications are that it won't bend to White House pressure to approve the three controversial issues either. Observers expect the Senate to approve a reorganization bill pretty much along the same lines as voted by the House.

Putting a man into space is getting closer . . . .

The Air Force recently put prospective pilots through simulated X-15 flights at the Naval Air Development Center, Johnsville, Penna. It was the third such test to date.

Pilots are put into a huge machine—dubbed the human centrifuge—and subjected to space flight conditions. It gives the pilots training and records their reactions to the flight conditions.

The X-15 is the highly touted research plane that is the forerunner to actually hurling a man into orbit—at least first experiments are slated only for altitude and data collection missions.

North American Aviation is building three of the planes. Here is the unofficial timetable: roll out of the first plane is due early this fall; drop tests from the mother B-52 that will launch the X-15 at up to 40,000 feet will be made later this fall; first glide test is slated for January 1959; and, the first manned flight for April.

The X-15 is highly advanced in design. It uses a nickel alloy steel for the outside skin with titanium and stainless steel structural members. The 50-ft long fuselage has tear drop "blisters" that extend almost the length of the plane. Wings are thin with blunt trailing edges to withstand aerodynamic heating. The plane will have mostly welded structure.

Air leakage through the skin . . . .

of refrigerated truck trailers is turning the multimillion dollar frozen foods industry to design engineers for help.

Recent tests conducted by the Bureau of Standards with results still not publicly announced show that air leakage is a major cause behind the damage to present shipments of chilled and frozen foods.

The current design of refrigerated trailers—reefers—is considered good if the air leakage can be stopped. What is needed is a vapor barrier material that can be applied to the inside of the exterior skin. Test results may be made public within a month or so.

Hearings on the 1951 renegotiation act . . . .

may be forthcoming. Although they are still not scheduled, Congress seems to be leaning in this direction. The legislators must act on the measure this session or the act expires on December 31. Secretary of Defense McElroy has asked for another two-year extension of the measure. And, there is little doubt that the act will be extended as requested.

Industry, however, is pumping hard to get some amendments. Primarily, it wants new ground rules written on government recapture of profits earned under incentive contracts, sometimes as much as four years after payment.

World-wide ...

DEVELOPMENTS TO WATCH...

Engine oils that reduce wear . . .

. . . can be produced from a low-cost, abundant farm crop, says Dexter H. C. Beach of the U. of Saskatchewan's agricultural engineering department. Lubricants made from rapeseed oil, alone or in combination with petroleum products, also perform well at temperatures at least to minus 20 F. Their over-all temperature stability, is still open to question, but results so far promise enough to warrant further study. Too, though the 10 to 15% improvement in wear so far achieved may not be enough to dictate use of these oils in auto engines under normal conditions, they may well have special applications.

Fibers from mulberry, oleander . . .

. . . and even cotton stalks are being woven into cloth in Red China and, the Chinese claim, their new processes produce fabrics "as good as cotton" in sheen, resistance to acid, and dyeability. They admit, though, that these new wood-derived fibers don't quite come up to cotton in tensile strength, and they make no statement on wearability, or on possible industrial applications.

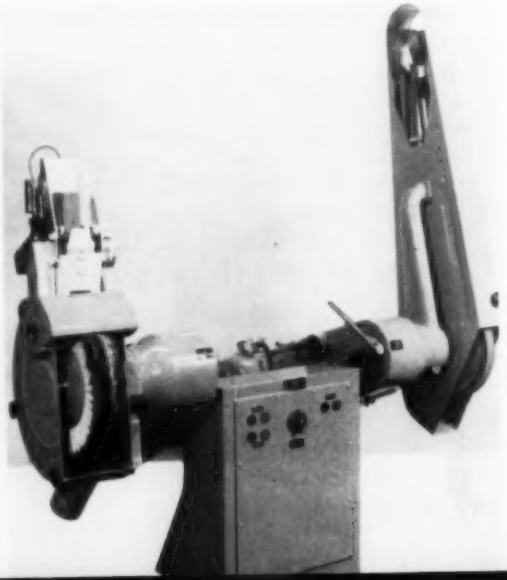
Unusual metal powders . . .

. . . and advances in powder metallurgy are expected from a Canadian plant scheduled to start operation in the next few months. The plant, being built by Metal Atomizing and Processing Corp., at Oakville, Ont., will use an atomizing process to force air through the molten metal and break it up into powder. There will also be facilities for hot-rolling and die-casting the powders, and for continuous conversion of the powder into shaped parts (bearings, gears and the like), Canada's *Financial Post* reports.

Metal Atomizing, a subsidiary of Jacobus Mining, will initially supply brass, bronze, nickel-silver, stainless steel and other "standard" powders, but George Monteith, Jacobus president, says research will concentrate on such "new" metals as zirconium, beryllium, columbium, and titanium. Flexibility of the new plant will make it possible to produce any or all of these, Monteith believes. He hopes, too, that new mixtures of plastics and metals, and of ceramics and metals, can be developed with the new process.

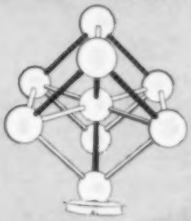
Adjustable work height . . .

. . . is the key feature of this new West German grinder and polisher. It's "human engineered" and flexible in other ways too: The polishing wheel has an automatic wax dispenser; speed of wheel revolution is adjustable; and the machine can deliver anything from 3 to 12.2 hp on either side. The manufacturer of this machine is Grief-Werk GmbH, Hagen-Haspe, Westphalen.



To fit short men and tall, this new grinder can be raised or lowered at will. Minimum work-level height is said to be 30 in.; maximum, 36

RESEARCH MEN
DESIGNERS
ENGINEERS
MEN OF VISION



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The primary market for Microbeads is in the field of reflectorization—signs, pavement markings, etc. They have gained wide usage in traffic control products and in the medium of outdoor advertising. We feel, however, that these uses are only the beginning . . . a small portion of the overall role Microbeads is destined to play throughout industry. This thinking is prompted by the many men of vision who have approached us with imaginative ideas for new uses of this product. Some are practical . . . some are not. However, an amazing percentage of these ideas have proven themselves to be both practical in use and feasible from a cost standpoint.

The material contained in the contest kit describes a number of these suggested new uses. Perhaps one of them will spark an idea within yourself . . . and you'll find yourself winging your way across the Atlantic . . . bound for an unforgettable two weeks at the FAIR.

Contest Kit contains samples of Microbeads, general information, fact sheet, official rules, official entry form . . . everything you need to help you win.

Those ideas win which, in the opinion of the judges, will create the most jobs in the next five year period and which most successfully combine originality, feasibility and practicality. The idea itself is all-important; not the depth of development. Serving on the panel of judges are: Dr. R. P. Dinsmore, Vice President Research and Development, Goodyear Tire and Rubber Co., Akron, Ohio; Dr. H. W. Welch, Jr., Director Research and Development, Military Electronics Division, Motorola, Inc., Phoenix, Arizona; Mr. John J. Hanlon, Technical Director, Mohasco Industries, Inc., Amsterdam, New York.

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What's happening in SCIENCE

More magnetic materials on the way?

Magnetic properties have been found in an intermetallic compound that contains none of the common ferromagnetic elements, Bell Telephone Laboratories reports; and, says B. T. Matthias of BTL, this discovery indicates that "ferromagnetic and perhaps anti-ferromagnetic compounds may be formed by the combination of many more metals than had been supposed until now."

The compound he's been studying is a combination of zirconium and zinc.

It's not magnetic at room temperature; but at temperatures below 35 K (−396 F), its ferromagnetic characteristics are "similar to and of the same order of magnitude" as those of conventional ferrites at room temperature. (For more information on the behavior of materials at ultra low temperatures, see "cryogenics," below.)

Toward thermoelectric power

There's no trick to direct conversion of heat into electricity. There are a good many ways to do it (*PE*—Nov. 25, '57, p. 9, and Apr. 14, '58, p. 60) and some are already in limited practical use. Current research is concentrating on making the conversion on a large scale with a reasonable degree of efficiency; and one answer to this problem as well as to the demand for new magnetic materials may lie in the semiconductor field.

Researchers at NYU, for instance, point out that to take advantage of thermocouple-type circuits, materials are needed that combine high electrical conductivity with low thermal conductivity. "Elemental semiconductors like silicon and germanium," they admit, "do not have optimum properties for thermoelectric applications." But intermetallic semiconductors, with their large interatomic attractive forces, "freeze atomic vibrations and lower the thermal conductivity." The electrical conductivity of such materials is also low, but NYU scientists believe additions or "doping agents" can be found to help overcome this limitation.

Among the compounds being studied: the chalcopyrites, copper-iron-sulfur compounds that are structurally related to the diamond.

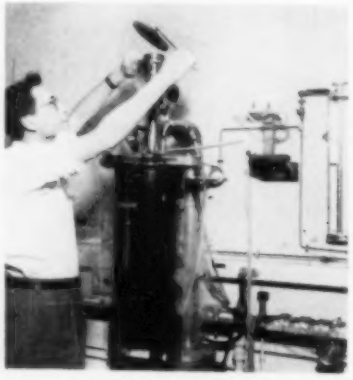
New words—II

Continuing our glossary of new scientific and technical terms (*PE*—*June* 16, '58, p. 10); here are more "names in the news."

Magnetohydrodynamics: the science of controlling fluid flow. It capitalizes on the fact that the movement of ionized air and electrically conducted fluid can be directed by the application of electrical and magnetic fields. This opens possibility of new forms of propulsion, new ways to protect high-speed aircraft from frictional heating, and new nuclear power plants. (*PE*—Sept. 23, '57, p. 17; Mar. 3, '58, p. 18; May 5, '58, p. 12). Other phrases applied to this phenomenon: magneto-fluid dynamics, magneto-gas dynamics, hydrodynamics, magneto-aerodynamics, gas dynamics.

Cryogenics: the study of the effects of ultralow temperatures (from −280 F to absolute zero) on materials and their use in mechanical, electrical, and electronic equipment (*PE*—Dec. 2, '57, p. 16). Such effects include useful phenomena like that described above, as well as damaging one.

Electrogravitics: the science which deals with control of gravity, and seeks ways to explain it, shield it, and put it to work. (*PE*—Dec. 30, '57, p. 12 and Mar. 10, '58, p. 14.)



This cryostat, basic research tool for low-temperature studies, is used by Bell Labs scientist to study magnetic properties of zirconium-zinc compound.

briefs . . .

New gravity theory, proposed by Dr. Leonard I. Schiff of Stanford U, bypasses conventional theories and puts new ideas on matter and anti-matter to work. Gravity, he suggests, may result from the exchange of neutrinos (tiny, uncharged nuclear particles) or from neutrino–anti-neutrino pairs. The theory, he emphasizes, is still in its early stages, but it may prove a real breakthrough on the gravity horizon. (For other new ideas on gravity and gravity control, see *PE*—Mar. 10, '58, p. 14 and June 16, '58, p. 10.)

How does TEL prevent knock in gasoline engines? Despite the length of time tetraethyl lead has been used, engineers still aren't sure. Latest suggestion, from Ethyl Corp.: The real antiknock action may be removal of active oxygen (from products of fuel oxidation) by lead oxide particles formed when TEL breaks down in the engine. This, says E. B. Rifkin of Ethyl's Detroit Research Lab, might explain why TEL's action sometimes is inhibited by sulfur and other compounds. These "impurities" may combine with the lead oxide particles, converting them to nonactive compounds.

Silicon metal in a form especially designed for research is being made available by Sylvania Electric Products, Towanda, Penna. The form: cast polycrystalline rods, 4 to 15 mm in dia. They're offered in three standard grades, based on resistivity; are "ready for floating zone repurification without further processing." —ARG

What's happening in MATERIALS

Ceramics made easy

Cold-cured ceramics "equal in performance to disks prepared in the conventional manner" can be prepared by a new cold-curing process, Naval Research Laboratory reports.

With commercial-grade barium titanate powder and a carnauba wax or liquid sodium silicate binder, NRL says disks can be produced for use with commercial amplifiers that provide "clear, undistorted speaker output not audibly different" from that obtained with standard piezoelectric materials.

The disks must still be fired; but, says NRL, "firing and polarization can be accomplished in one simple operation, thus eliminating the more elaborate two-step procedure usually required."

A description of the process is contained in Report PB 131,523, available from Office of Technical Service Department of Commerce, Washington 25, D. C. Price: 50¢.

More controls on materials

New regulations on use of potentially harmful compounds, and labeling of products containing them, are on the way.

In recent months, three new Federal bills have been introduced, two more states are readying legislation, and others are likely to follow suit.

Biggest problem these laws pose for the designer is not in the fact that there are controls, but in the infinite variations and combinations of rules which can bar a product from one state while it sells freely in a neighboring one (*PE*—Dec. 30, '57, p. 6), and make it necessary to check with the legal department before specifying even the commonest materials.

As Chester L. French of Mallinckrodt Chemical Works told the Manufacturing Chemists' Association Conference on Precautionary Labeling, at least five Federal agencies now have the power to control use of various industrial materials; eight states and the Territory of Hawaii have passed labeling laws; and several cities, too, keep a watchful eye on hazardous compounds. Indeed, says French, "many of the municipal labeling requirements are much more effectively enforced than are the labeling provisions of some of our States."

One point of progress: MCA and the National Academy of Sciences have pinned down the distinction between "toxic" and "hazardous" substances. Says MCA:

Toxicity is the capacity of a substance to produce injury.

Hazard is the probability that injury will result from the handling or use of the substance in the quantity, frequency, and manner proposed.

MCA also recommends that the term **poison** be limited to products having a definite toxicity standard.

Price tags: the high ones are down

This month, high-purity silicon joined the rare earths and other costly-but-useful materials in the price descent that's good news for users.

Now priced at $90 to $320 a lb., silicon is down $10 in the past month; $40 in a year, $90 in 2 years. (Some of the rare earths have done even better: several thousand dollars a pound—see below.)

Other new materials are coming down in prices—and some older ones too. Nylon cord, in the heavy deniers required for tires, is down 10¢ a lb (to $1.20), and lead hit its lowest level in almost 10 years early this month. Looking up a bit, though, is copper, which has been fairly stable in recent months.

Both nylon and steel cord are used in this new Goodyear combination. Nylon is used for the carcass of the tire itself; steel cord in the safety shield. Sidewall valve facilitates shield installation.

briefs . . .

For camera bellows, instrument covers, and other applications "requiring a high degree of mar resistance," DuPont has a new, opaque, coated Armalon fabric. Described as an "ethylenic resin," it is said to be unaffected by contact with lacquered surfaces. The material is offered in black and gray in 0.007 and 0.010-in. thicknesses. Sample swatches may be obtained from Room 7031-D, DuPont Building, Wilmington 98, Del.

Additional data on dysprosium, newest of the rare earths to be made available commercially (*PE*—June 16, p. 11), comes from Research Chemicals, Inc., Burbank, Calif.:

The metal melts at 2550 F (quite high for members of this group); has a specific gravity of 8.55; specific resistance, 5.6 x 10^{-6}; thermal conductivity, 0.024 cal/cm²/cm/sec/°C; specific heat, 0.041 cal/gm/°C.

Big push for bentonite, a mineral whose uses already range from metal-casting to paint-formulation, is coming from Chicago & North-Western Railway, in whose territory large deposits are found. A highly absorbent natural clay, bentonite is used in dry cells, rubber products and insulating materials and now shows promise as both a filler and chemical raw material for plastics. A prospectus on bentonite and its industrial possibilities has been prepared by the railroad, and copies may be obtained by writing to W. A. Kluender, Director, Agricultural & Resource Development, C&NW, 400 W. Madison St., Chicago 6.

—ARG

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The FSH now is available in a wide range of sizes for dependable control application on industrial, construction and materials handling equipment.

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Long-Life Lining. Brake lining is bonded to the shoe to give maximum lining area.

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Positive Contact Drum Seal. Where a sealed brake is required, the FSH incorporates a seal between the brake backing plate and brake drum.

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LEARNING IS POWER

Everybody in Europe reads, studies, tours—very seriously. This is a major impression after six weeks, my best answer to the question, "What's it like over there?"

The French peasant and the office worker, in the midst of political chaos, read serious books during the noon-time break, visit art museums and historical monuments on days off. The German engineer studies an economic volume, the Swiss shopman digs away at astronautics, the Italian researcher becomes an expert on wines and small cars, the Russian chief engineer takes his Sunday to guide visiting engineers to a famous monastery and to a poet's home. Bookstalls are almost as common in Moscow as mineral-water or ice-cream stands, as common in London as tobacconist shops. Swiss and Italian plants maintain free libraries and art collections.

It is difficult to explain to an American the intensity, seriousness and drive of these European seekers after knowledge. The schoolboy spends his Sunday on a group trip to museum or art gallery, the university student spends his free hours studying and reading in non-curricular fields—and both study, study, study their lessons as well. Busloads of peasants and workers go from gallery to museum to historical building to have guided tours. Others go on bicycles, scooters, afoot.

Nowhere is this intensive drive for information, for culture, more evident than in the USSR. The latest transfer line of machine tools, bus, agricultural machine, electronic gadget—is set up to work for six months in the Industrial Exhibition, open to all people, not just a chosen few. Each republic builds and maintains its own permanent exhibit building in the huge Agricultural Exhibition on the same grounds in Moscow (and the peoples, more polyglot by far than Americans, visit them all). Explanatory models of integrators, computers, calculating machines, are demonstrated in the all-year Polytechnical Museum. Endless art galleries and museums, the Kremlin museums and buildings, monasteries, estates and monuments are crowded with visitors on guided tours. So are manufacturing plants, laboratories, institutes.

We talk of the importance of the humanities to engineers, of engineering and science to the layman. But we are so fearful that "Jack will be a dull boy" that our leisure hours are crammed with TV, sports, fast cars, and relatively aimless pursuits. The European plays too, but at odd moments; his major "leisure" time (often far more limited than ours) is devoted to self-betterment.

In these countries, the "egghead" is not only respected—he is also well paid. More credit is given to a man for being "cultured" and well-read than for being rich. I quote the word "cultured" because some of the drive for knowledge appears to be intellectual snobbery, a study and memorizing of the attributes and work of artists long dead. But some of it knocks off the rough corners and rounds the individual, gives him a variety of interests and a broader outlook. It also keeps him from thinking, as so many did until last October 4, that the "egghead" is anti-social and a bit crazy.

This does not suggest that Americans should become museum, library and art-gallery habitues. But it does suggest that we'd be better rounded, better citizens, even better men if we did more of it.

As usual, the best philosophy of life and thought probably lies somewhere between the extremes. We need to learn to put some of our leisure time into pursuits that enlarge the mind, they to put some into pursuits that relax it.

K. Stangerman

War Games Point Future Equipment Design

• What will be the problems and equipment needs of an Army in a 1970 war? California combat experimentation center carries on carefully planned experiments to come up with right combination.

• Simulating devices make battle more realistic as extensive data collection equipment keeps score.

FORT ORD, CALIF.—Parameters for weapons, mobile personnel carriers, communication devices and other equipment necessary for successfully waging future ground warfare are being established at a unique experimental center here. Called the US Army Combat Development Experimentation Center (CDEC), its headquarters are at Fort Ord, with the mock battles and experimental work taking place 80 miles south on 216,000 acres of rolling and mountainous terrain at the Hunter-Liggett Military Reservation and Camp Roberts.

What CDEC, plus a small group of civilian scientists, does is experiment with variations in organization, weapons, equipment, tactics and techniques in various phases of warfare over varied terrain to determine the best combination of these against a known or possible enemy. In planning for battles of the future, CDEC does not deal in terms of specific pieces of equipment. It deals with objectives to be gained. It reports to the R & D section of the US Continental Army Command, Fort Monroe, Va., which in turn evaluates the effects on tactical doctrine and new scientific developments, and has the responsibility of developing requirements for new weapons and equipment to meet the demands of these new tactical concepts.

CDEC is not thinking in terms of how the divisions and corps will operate under the concepts of operations of the future, but is trying to solve first how platoons and companies will operate and what support they will need. CDEC feels that this approach is essential because the platoon of the future may prove to have the battlefield capability of the present company. (Frequently, the words "platoon" and "squad" are not used; rather, the term "Type A Echelon." This is a unit of 90 men which is expected to be more potent, have greater firepower and range than a unit of 250 men.) The broad concepts developed by the Dept. of the Army will be checked to see if they are feasible and if not, to determine where the failures take place.

Infra-red umpire . . .
is aimed with gun. All vehicles in maneuver will have infra-red "target" pickup which will indicate by flashing light if hit to operator of target vehicle. His equipment is then considered knocked out of the game.

THE FUTURE WAR

An important factor in the development of CDEC's long-range philosophy is that it will not continue to accept new weapons and equipment that have not been developed to meet a definitely established military need. CDEC feels that industry should adopt the approach of "what do you need?", rather than, "can you use this?" Lt. Col. R. M. Lee said, "There is literally no limit to the kinds of equipment which the technical brains and industry of our nation can develop and produce. But the development of such material, resulting from such isolated ideas and without regard to its tactical use, forces the tailoring of military operations and organizations to fit the capabilities of the equipment. That is a most inefficient and expensive way to maintain a progressive Army."

Two programs are underway: a mid-term program based on equipment expected to be aavilable by 1962; a long-range program which looks beyond 1965. By 1961, CDEC is scheduled to recommend tactics, organizations and materiel requirements that will be keyed to an R & D program with an expected date of availability of 1970. The objective in this timetable is to take the initiative from an enemy and keep him in a position of trying to overtake our developments.

No fall-out . . .
in this simulated tactical atomic bomb blast, above, which produces a very realistic mushrooming affect. Innocent looking kegs, below, produce the smoke, yellowish flame, and noise. Large kegs hold metal powders (magnesium, aluminum, etc.) while small containers hold black powder.

CDEC bases its planning for future wars on these points: they will be fought with atomic bombs, or under the threat of their use; the Army must have a dual capability (use of conventional weapons as well); greater mobility of troops with radically new vehicles; the value of the terrain must be assessed in new terms; engagements will be brief and violent and of the hit and run nature; there will be no such thing as traditional infantry, artillery units in the forward forces.

WHERE THE SCIENTISTS FIT IN

Under contract to CDEC is a civilian group of 23 scientists called Technical Operations, Inc. Its function is to gather the data obtained in various military maneuvers. Together with military representatives, this group discusses the broad areas of in-

vestigation, points out areas most appropriate for field experimentation, develops the program, determines instrumentation requirements, simulation requirements and umpiring methods, develops analysis and evaluation methods, and goes into a host of other problems. A scientist in this group does not work directly on hardware improvement—better munitions, radar, a jeep that flies, a faster tank, etc. His interest is in experiments designed to achieve certain objectives, and passing results on to higher authorities for possible inclusion in Army R & D programs.

Collecting data is itself a complicated procedure. Planning for a specific experiment often starts more than a year in advance. Such civilian evaluation has been shown to be effective—the Army readily admits that its own men have been biased when evaluating Army games.

Since no live ammunition is used, umpires in jeeps follow tactical maneuvers of both sides in the field and determine, for example, when a tank, personnel or gun-carrying jeep has received a direct hit. An umpire relays this information back to the data-collection center which keeps an accurate score on the entire operation.

EXPERIMENT RESULTS

In a recent experiment where small yield atomic weapons were used, a pattern developed with respect to groups in the forward battle area. While not conclusive, it was observed that: it is questionable if human beings can survive in the atomic battlefield unless they are in small, highly mobile, armored vehicles; a powerful direct-fire weapon capable of killing any other armored vehicle will be needed in this vehicle; a squad of very minimum size is required to man the equipment; equipment is necessary to keep the squad leader informed at all times of the location of the squad on a widely dispersed battlefield and to keep the squad itself informed of its own location; vehicles should operate in pairs; an armored air vehicle capable of operating very close to the ground, hovering or moving at a great speed appears to be desirable as a squad vehicle.

Generally, replays of the different experiments are made to consolidate the scientific data that was collected with the military observations and to develop tentative conclusions.

SIMULATORS GIVE REALISM

Currently in the test stage at CDEC is an infra-red umpiring device which eventually should reduce the number of umpires used in an experiment. The infra-red system is attached to the gun and aimed at an "enemy" vehicle. When the blank shell is fired (completely simulated with smoke and noise) and if a hit is scored, an infra-red pick-up device acting as a target flashes a light on the target vehicle's control panel. The operator must stop the vehicle immediately and declare it out of action with a yellow smoke flare.

Eventually, scientists at CDEC hope, this method will be streamlined so that when a hit is made, information will automatically flash back to the data-processing system at the data-collection center. An automatic up-to-the-minute account of the vehicles and groups out of action will be kept there. Such data will include the kind of vehicle hit, type of weapon making the hit, exact location of the action and the time and number of casualties.

Such war games create a demand for more realistic and inexpensive simulating devices. The 106-mm recoilless rifle and the 3.5-in. rocket launcher have simulators consisting of a small powder charge that fits into an empty shell so that the gunner has the feeling of actually loading a full-size projectile. A loud noise and much smoke completes the actual firing simulation. For example, a simulated atomic bomb blast is complete with mushrooming cloud, bright yellow flame, and thunderous explosion. Its ingredients are five medium-size kegs containing mixtures of various metal powders and five smaller packages with black powder. Adding necessary electrical detonating equipment gives a total cost of about $300 per explosion (above left).

Blank cartridges are expensive, particularly if the equipment to be simulated is a machine gun. CDEC now uses a noise-making device consisting of the proper quantities of acetylene gas and oxygen in a small chamber, with ignition provided by a spark plug. This device works when the trigger is pressed (above).

Helicopters of all sizes are used extensively in ground maneuvers, and to simulate other weapons. A recent development is a drop zone lighting and navigation system. It consists of a series of lights set up at a strategic spot by a ground crew needing equipment, fuel, ammunition, etc. which will be dropped at night by helicopter. The lights are radio controlled at will by the pilot on his approach and during the drop. Other than the initial spotting of the lights, the pilot needs no assistance from the ground.

Cheap rat-a-tat
of a machine gun is produced here with a device which uses only acetylene gas, oxygen, and a spark plug in a small chamber. It works when the trigger is pressed. Blank cartridges are more expensive.

FULL-FLEDGED MEMBER

In the trial stage for several years, CDEC has just been informed by the Dept. of the Army that it can regard itself as a permanent fixture in the Army's new phase of operations. CDEC's Commandant, Brig. Gen. Frederick Gibbs, feels that the surface is just being scratched on the work needed to project the requirements of waging a war of the future into present-day R & D programs.

Columnated light . . .
mounted on barrel of this tank gun can be seen 5000 ft. when gun is fired, if occupants of target vehicle, which include umpire, can see light, they are declared out of action. Cluster of seven cartridges mounted near top of turret simulate the smoke and blast of the firing of the tank gun.

LeTourneau Comeback:

Mass-produced Electric Wheel for Giant Jobs

LONGVIEW, TEX.—R. G. LeTourneau, president and chief engineer of LeTourneau, Inc.—and only recently returned to the mammoth machine and earth-moving industry after a 5-year, self-imposed absence—believes the future of his business lies in a shifting of design gears to mass production.

And he points to the electric wheel—an electric motor geared directly to the rim of each wheel—as the production item that will spark the trend to mass production. The idea cost him $12 million to develop.

"We're well on our way with the electric wheel. These same wheels will power a disk plow, a crane, an off-the-road transport, a bulldozer or a scraper," he explains. "I'm not so sure the day won't come when I will build only main mechanisms, and let the man down the road build the body he wants."

LeTourneau holds some 250 US patents, and is credited with many of the basic designs being marketed by earthmoving-equipment manufacturers today. Little more than five years ago, he sold his business to Westinghouse, agreeing to stay out of the earthmoving business until last April. Now he's back, bubbling with plans for the future.

His motor-wheel idea has led to announcement of a trackless, cross-country train. It has all-wheel drive for 52 wheels, with an electric motor geared to each wheel. He calls this a considerable advance over previous trains built by the company. Complete steering controls are installed at both ends to facilitate reversibility; equal speed and power can be achieved in either direction.

The train features a highly simplified suspension system (patentable) through unique arrangement of walking beams and oscillating axles. LeTourneau representatives add that the train has been designed to accommodate a nuclear power plant as well as conventional type engine (a high-horsepower diesel). If nuclear-powered, the reactor, and the generators it would drive, would be located in tail section of the train.

Motors in the wheels will be dc-powered; ac will be for the controls. Tires will be 10 ft high, 4 ft wide; train length will be 450 ft; power supply will total 2000 hp and more.

Describing his electrical wheel, LeTourneau says: "I started work on this about seven years ago. Electric power has many advantages. There's ease of starting—you can transmit energy to the wheel with greater efficiency. Dc motors give automatic reduction of power in inverted ratios, automatically swinging into place the most efficient operating ratio. There is practically nothing to wear out."

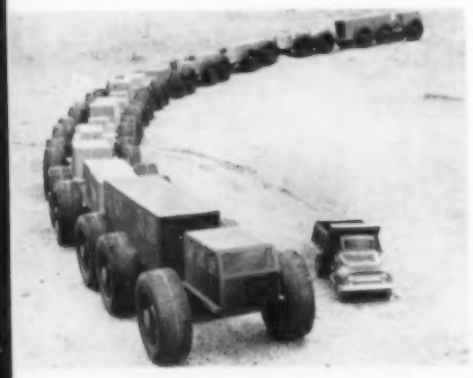
Regarding over-all production plans, LeTourneau would say only that on his re-entry into the earthmoving business his equipment will be big; that by his standards a 23-ton machine will be a small one; and only a 150-ton vehicle will approach what he considers the large-size class.

"Why use 1,000 machines when one can do the job, especially when I can build the one machine for the same price? It doesn't take a bigger man to run the big one although he may have to be better trained; but, by the same token, the machine will be better maintained," LeTourneau says.

Appropriately from a geographical standpoint, LeTourneau takes the long view in any evaluation of design engineering. It takes time, he says, a lot of horse sense, a lot of figuring, and a lot of money. "The real job is to pick the good ideas out of the many that exist. The electric wheel is an example of a good idea that others knew about. I have a whole crew that have ideas. If I can get a lot of ideas, I can usually come up with a honey of a final idea."

R. G. LeTourneau, president and chief engineer, LeTourneau, Inc., Longview, Tex.

Cross-country train . . .
that runs on 10-ft-high rubber tires with all-wheel drive for its 52 wheels, could be powered either by atomic reactors or conventional diesel-electric units. The LeTourneau concept is shown here as a model beside scale model of a large dump truck.



IN-PLANT STEEL MILL

LeTourneau operates a steel mill at the Longview plant, claims he can make a steel that for 20% greater cost provides 50% more strength than the high-strength, lightweight weldable alloys. This steel is also lighter, and results in machines capable of enduring thousands of extra ton miles each year. He says that as half of tensile strength is needed to stand shock, you don't allow a 5-to-1 safety factor, because that way you would have a machine that you couldn't drag about.

Equipment that LeTourneau has produced over the years includes: mammoth logging arches, each capable of skidding 28 tons of logs over rough trails; rough-terrain fork lifts that can unload up to 50 tons of logs from a truck with one bite, a steam-roller type of jungle destroyer that smashes trees and undergrowth into a ground carpet, portable islands for offshore oil drilling, and huge loaders that can lift a missile from the ground, carry it piggyback over rough terrain, then erect it for launching.

But now LeTourneau wants to concentrate on achieving mass production items: "We in this industry must get prices down. And while there are many different kinds of earthmoving machines, all have parts that can be mass-produced. For that reason, we have two wheel sizes, and we don't want any more, because we have a lot of production on each", he says.

Avco Noise-maker Will Assist in Missile-Rocket Tests

LAWRENCE, MASS.—An acoustical noise generator, capable of testing any number of rocket or jet components for vibrational endurance, has been developed by Avco Research and Advanced Development Corp.

Exceeding in scope any other equipment of its kind, the Avco-Acoustical Noise Generator produces random noise (as contrasted with single frequency) at a sound pressure level of 165 decibels in a 4-in. dia. plane wave tube. At single frequencies the generator can produce a sound pressure level of 173 decibels in a range of 80 to 500 cycles per sec.

In principle, the generator is little more than an oversized loudspeaker measuring 35 in. high, 26 in. wide, weighing approximately 1 ton. It can be coupled to a plane wave tube, a reverberation chamber, or an exponential horn to produce either random or single frequency noise.

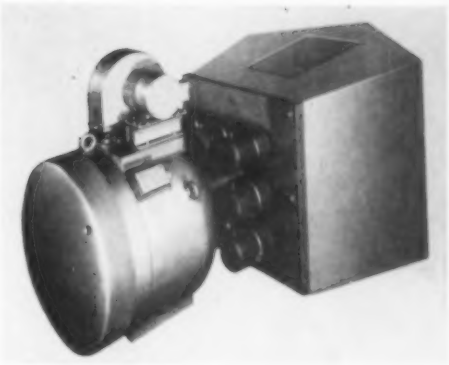
Equipped with a variety of adjustment mechanisms, the generator is designed to accommodate a wide range of frequencies and power levels. Among advantages is possibility of achieving sustained efficiency of random noise for periods longer than that obtained by previous devices.

Components to be tested are hung from hooks in a reinforced concrete test chamber. A blast of compressed air is channeled through the tube from the generator. Arriving in the test chamber, the air noise submits the components to severe vibrational stress. This vibration reaches a maximum of resonance shortly after testing begins, and affects the component being tested not only upon entrance of the air into the chamber, but also after the air ricochets off the chamber walls.

Avco engineers say significance of the development lies in ability to create a collection of different kinds of noises—different in frequency—simultaneously; and ability to control them to meet test specification needs.

Closest to the Avco generator is an RCA noise-making system that embodies similar operating principles but is effective only for testing small components.

The advent of missiles and rockets, and their high-intensity noise that causes excessive vibration, brought the need for adequate test facilities. Already the military has indicated it will now set up specifications for noise generation testing procedures as a result of the Avco development.



Noise machine . . .
Avco's Acoustical Noise Generator, at left, is shown with a reinforced concrete test chamber on which are attached additional drive mechanisms. They increase random frequencies where necessary.

Lower Cars-But Where to Put Passengers?

ATLANTIC CITY—The persistent trend toward lower cars, which is likely to continue, raises the problem of finding space to seat the human cargo, Philip O. Johnson, Fisher Body engineer, told the SAE convention here.

"Extremely low profiles have been achieved in many European cars and in several American cars of the 2- and 4-passenger variety," he noted. "But no one here is producing a 6-passenger car without having two passengers sit astride the hump that houses the driveshaft."

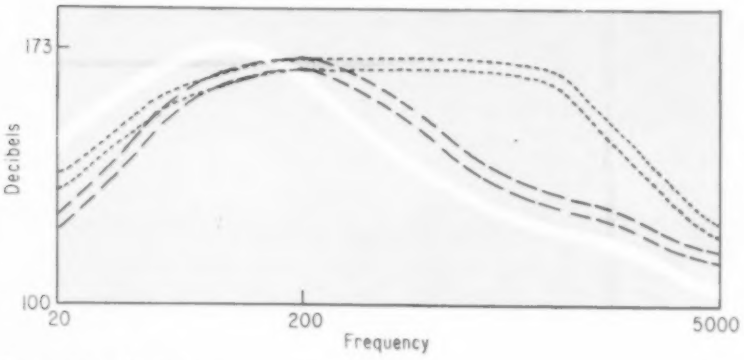
Hence, he said, height of the driveshaft hump—rather than choice of integral or separate chassis frame—determines how close to the road the engineer can design a car.

(Many European cars eliminate the objectionable hump by placing the engine over the driving wheels. In some cases, engines are installed in the front of the car for front-wheel drive; in others they're at the rear. And though this solution creates a weight-distribution problem, US engineers will conceivably seek a solution along these lines—Ed. Note)

The problem is not one for the car-body engineer alone, said Johnson. He'll need help from engineers working on suspensions, transmissions, drivelines, exhaust systems, and chassis frames.

"Because of the limited space in which we have to work," he added, "it may be necessary to find some new concepts and new materials for future car seats."

Compression ratios up to 17:1 may pay the motorist dividends in miles per gallon, said Darl F. Caris and Edwin E. Nelson of GM's engineering staff. They based the assertion on tests of compression ratios up to 25:1. Ratios above 17:1 are not feasible with present engine designs, the engineers said, because the combustion process is delayed or the air-fuel mixture burns in the combustion chamber.



Frequency chart . . .
Dotted line shows frequency range of noise achieved by Avco engineers to date; short-dashed line shows what can be achieved. White line shows future goal.

Porcelain-to-aluminum Seal Is Simple but Powerful

PITTSBURGH—A method for sealing aluminum to high-tension electrical porcelain has been devised by Westinghouse Electric's ceramic materials engineers.

Requiring no intermediate materials, costly vacuum or atmosphere heat treatments, the method produces a mechanically reliable, vacuum-tight seal. It's done by bringing high-purity aluminum in contact with porcelain or other alumina-silica ceramic, under carefully controlled temperature and temperature-change conditions.

The seals can be used in transformers, circuit breakers and capacitors where substituting aluminum for steel or other structural material is desirable. However, the process is still in the lab development stage.

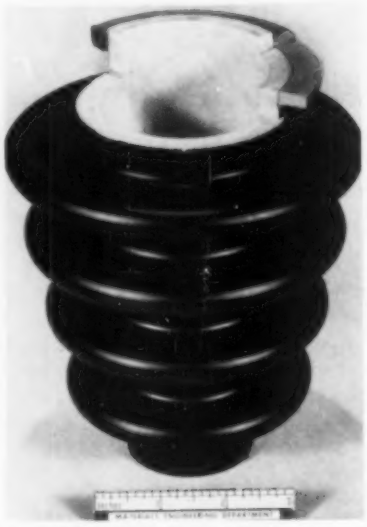
The technique eliminates disadvantages of other methods for making the seal: failure by leakage of mechanical seals (threads or shrink fits) caused by differences in thermal expansion; and leakage of organic sealing and gasketing materials that deteriorate under the ambient conditions of apparatus use.

Materials required are a fairly pure aluminum and the glazed or unglazed porcelain. For an effective seal the temperatures and holding time at required temperatures is critical. Much depends on composition of the porcelain. Rates of heating and cooling are also important in preventing damage to the porcelain by thermal shock, and in achieving a desirable grain structure in the aluminum.

SEAL IS STRONGEST

Mechanical tests have shown the bond is stronger than either the parent aluminum or porcelain. In fact, when the seal is destructively tested in tension or shear, failure occurs most often in the porcelain, almost as frequently in the aluminum and seldom at the joint.

The big difference in thermal expansion between aluminum and porcelain is accommodated by the aluminum: high-purity aluminum is exceedingly soft and can flow to relieve such stresses. Thus seals are designed to have porcelain in compression and aluminum in tension. The seals have proved successful in cylindrical form, with the porcelain surrounded by and compressed by the aluminum.



Porcelain-aluminum bond . . . Cross-section view at top of bushing illustrates Westinghouse seal of direct aluminum-to-porcelain—no need for intermediate materials, costly vacuum or atmosphere heat-treatments.

Companies Group Together for Big AF Job

DALLAS, TEXAS—Seven companies headed by Temco Aircraft Corp. have made a group proposal for a US Air Force all-weather reconnaissance system.

The proposal was developed by a pilot team of representatives of the companies under the direction of I. Nevin Palley, Temco senior vice president. The team includes Goodyear Aircraft Corp., Radiation, Inc., Northam Electronics, Inc., Electronic Communications, Inc., American Institute for Research, Aerophysics Development Corp., and Temco.

Palley said the novel aproach to the all-weather reconnaissance project was necessary because the system is of such magnitude that no one company could economically muster enough of the scientific manpower needed. The project gives small companies a chance to get in on large-scale programs they could not handle alone. Also, needed skills can be brought together.

Temco is responsible for the overall management of the group for the all-weather system and any related efforts.

Bits and Pieces

The Small Business Administration has drawn up a list of 1100 small firms that would like to bid on government research and development contracts. Purpose of the list is to cue the Defense Department on small qualified firms that could cash in on the $2.8 billion of government R&D work this year. . . . Sylvania Electric Products, Inc., has won a $2.6 million contract from the US Army Signal Research and Development Lab for "continuation of development work in electronics." This contract is an extension of one originally awarded six years ago.

McGraw-Hill index of new orders for machinery rose this May for the third successive month. The index reflects the course of orders for a very large segment of the machinery manufacturing industry, and suggests the capital goods industries may be pulling out of their recession. . . . Boeing Airplane Co. is increasing the maximum salary of its top engineering classification to $19,000 a year. Boeing has also reached tentative agreement with the Professional Engineering Employees Association for a 4½% wage hike and a special merit pool totaling 1½% of engineering wages to be distributed at the company's discretion.

All-transistor TV receiver has emerged from Mullard, Ltd., one of Britain's large electronic firms. Though far from commercial reality, the receiver promises substantial operating economies. Scan magnification will achieve a 100 to 1 power saving in horizontal circuits and a 4 to 1 saving in the vertical plane.

Progress in synthetic resins is aiding the cause of obtaining pure water through de-ionization. In a system developed by Paterson Engineering Co, Johannesburg, South Africa, water is purified as it flows through a vessel containing a mixture of bead-like particles, formed from two different types of resin. The particles are regenerated with dilute acid and alkali solution. In small units, the vessel is made of transparent plastic and the valves of polythene or ebonite. In larger units, the vessels are made of steel lined with acid-resisting material.

Magnetic-force Method Welds Vinyl-laminated Steel Sheet

CINCINNATI—A new contender—magnetic-force welding—has entered the struggle to find a versatile assembly method for parts formed from vinyl-laminated steel.

Developed originally as a precision method for joining low-resistance contact metals, the process has been modified for plastic-coated steel—fusion temperatures can be reached on the metal side without raising the temperature on the vinyl side enough to cause scorching or blistering.

The brief, localized, and precisely timed heat and pressure cycle characteristic of magnetic-force welding gives consistent, high-strength welds between plastic-laminated sheet and metal-mounting brackets, stiffeners, and other metal parts. Shear strength on 0.035-in. stock is 800 psi.

Electrodes cannot make contact on the vinyl side of the part, so developers of the process—Precision Welder and Flexopress Corp.—devised an indirect welding technique that places both electrodes on the metal side (see photo). The part itself completes the circuit. A projection formed into the laminated steel is located under one electrode and concentrates the heat at the weld point. Several welds can be made simultaneously by series or parallel welding techniques.

The process gives the designer another choice in a growing list of ways to assemble vinyl-laminated steel parts—adhesives, rivets, lock-seaming, staking, and stud-welding, for example—and shows promise for extending this basic material into new fields. Development work is underway on welding steel to other plastic coatings like polyester film and vinyl plastisols.

Hinges, cover-stops, handle-clips . . .
are resistance-welded to this portable-radio case without damaging vinyl coating of the steel—demonstrating value of the magnetic-force method.

Russian Exhibitors Grateful

NEW YORK—Gratitude for being permitted to exhibit his nation's equipment at the Fourth International Automation Exposition and Congress here was the nub of an address given by Mikhail A. Lesechko, leader of the Soviet delegation at opening ceremonies for the Congress.

"We thank the organizers of the . . . Congress for giving us this opportunity to acquaint American specialists with some of the achievements of Soviet instrument techniques. . . .

"We are glad to greet the organizers and the participants of the Congress also because it facilitates still wider and more objective acquaintance on a reciprocal basis. Among the achievements of our countries in the struggle for technical progress, automation occupies first place. We hope it will contribute to one of the noblest aims of mankind—that of increasing productivity and making human labor easier," the USSR minister said.

"We are equally glad that . . . Pres. Eisenhower has said . . . there are no obstacles at the present time for a vast expansion of trade relations between the US and the Soviet Union." (See photos below.)

New developments . . .
exhibited by the Russians at the show were this recording multi-point, null-balance pressure gage (left) capable of measuring and recording pressure, vacuum, or pressure differential inert gases simultaneously at 20 points. Maximum pressure measuring range is up to 20 kg/sq. in.; pressure-vacuum measuring range is 760 mm Hg. and 0-19 kg/sq. in.; pressure differential measuring range, 5 KG/sq. in.; accuracy: of indication ±0.5%; of record ±1.5%. In right photo are two optical pyrometers. One in foreground has range up to 6,000 C; one in background to 10,000 C.

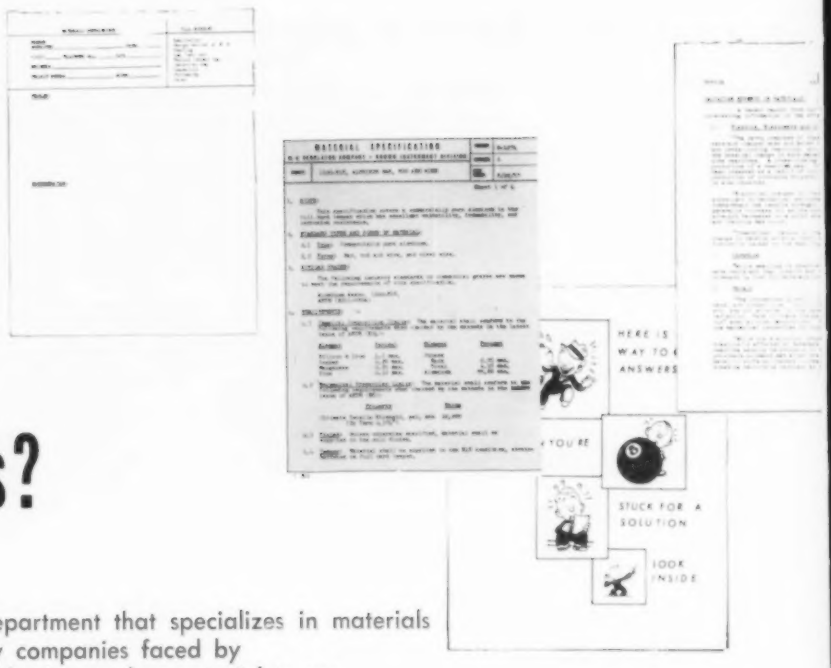
Undergrad Engineers Need Broader Base

DETROIT—Speaking before the ASME, James C. Zeder, vice president of Chrysler, said that engineering education today must give the young graduate broad basic knowledge "that will enable him to move with the times . . . in a world which demands ever-increasing flexibility and versatility."

Of the trend away from the study of specialized techniques in undergraduate engineer training, Zeder said: "I'm convinced this move merits far greater support from industry than it's now getting. And it merits far greater support from professional engineering societies and from some of the educators themselves.

"The most we can hope to accomplish in the four-year engineering curriculum is to give the student a solid base upon which to build his professional practice. His specialization should come from the graduate school or the company that hires him." He added that laboratory courses would still be essential to illustrate the fundamental application of scientific theory taught in the classroom.

Data sheets . . . prepared by a Materials Engineering Department, can help lead bewildered engineers out of the maze.



LOST in a maze of materials?

You don't have to be. A small department that specializes in materials engineering has paid off for many companies faced by a familiar problem—which metal, plastic or other material to use.

NICHOLAS J. PETRELLA
Chief Material Engineer, Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

■ Want to relieve a growing burden that eats into engineering time? A good answer is setting up a section devoted to materials engineering: it not only relieves the burden—it may mean the difference between success or failure of a new product.

It isn't lack of materials that is the problem; it's the complexity of choice. For example, there are almost two dozen basic plastics . . . 40 varieties of stainless steel . . . 35 different aluminum alloys. And as the list keeps growing, keeping pace becomes a full-time job.

Here is where materials engineering enters as a service department. It does more than keep the designer posted on new developments. It helps him select the right material for new products. Or it may suggest redesign with a material that does the same job at less cost. The production, purchasing and inspection departments receive valuable help too—as part of its duties, materials engineering tests new materials, gets reactions from vendors, prepares materials specifications.

SETTING IT UP

Where to put the new department on the organization chart depends on a company's complexity and raw materials requirements—on what departments are to be served and the kind of service required. Some companies call it a part of the engineering department. Others make it a staff function that reports to top management. Still others include it in quality control.

Organizing the unit may take considerable time—often a full year before it operates smoothly. Responsibility for its success lies largely with the man chosen as chief materials engineer. There is always some criticism and resistance to change, so he must be forceful and able to "sell" his group to others.

Size of his staff will vary. Typically, it will include about three or four engineers with differing backgrounds, assigned to handle specific problems in such fields as metals, nonmetals, raw materials. These men should be good salesmen, too, and the best sales qualities are a knowledge of the field, a pleasing personality, and an ability to give quick answers to difficult or poorly defined problems.

How will operation of this service group be financed? Two popular methods are: charge costs to company overhead; or tax each department using the service. Either way requires keeping track of time spent with each department. A convenient method is to assign a charge number to each department and charge time to this number whenever the service is used. Records then give a quick annual review of who has used the service and how often.

The company must also provide a place to file data and a working space where experiments can be performed. Working space can sometimes be found in the testing lab which is already doing some materials engineering. Or possibly a small, vacant area can be found in the plant.

10 THINGS MATERIALS ENGINEERING DOES

- Advises engineers on selecting proper materials
- Suggests substitution of materials
- Prepares materials specifications
- Tests samples and makes trial applications
- Maintains file of manufacturers' literature; samples of materials
- Interviews salesmen
- Reviews drawings for adequacy of materials specifications
- Helps develop specialized materials to meet company needs
- Passes materials information along to design and engineering departments
- Arranges for periodic educational programs on materials

THE TOOLS

A filing system is the group's key to efficient operation—quick access to vital information expedites solution of complex problems. Several systems are possible but one with two breakdowns—one for manufacturers' literature and one for specifications—is very often valuable. Further division can be into two groups—metallic and nonmetallic—with coded subdivisions. If each materials engineer has a copy of the code, it will be easy to find information and file new data properly.

A small reference library should back up the files with quickly available textbooks on materials and engineering. Handbooks and manufacturers' data books should also be included.

A consultation sheet will simplify keeping score on requests for assistance. It should be used for any project requiring more than one hour's consulting time; should include such information as person contacted, date, project number, hours spent, description of problem, and recommendation made. Reviewing these forms from time to time will indicate trends in materials problems and show where materials emphasis is needed.

Raw materials specifications are often the basis for decisions made by the materials engineer. These specifications may come from military or ASTM standards, or from other companies and suppliers. They make it possible for company buyers to purchase the best materials at lowest cost. Without such specifications, the inspection department could not determine if submitted materials meet established quality levels.

A list of qualified suppliers is a logical companion to materials specifications. It names manufacturers who have met company requirements. The purchasing department may have primary responsibility for furnishing such names and contacts new vendors only when a new source of supply is needed. This prevents vendors from taking advantage of the company's testing facilities. One way is to have vendors send data first. If data is acceptable, samples are tested and the vendor informed of qualification—or disqualification—and why.

THE CHALLENGE

In its early months, the materials engineering section can expect some resistance. Here are a few familiar roadblocks.

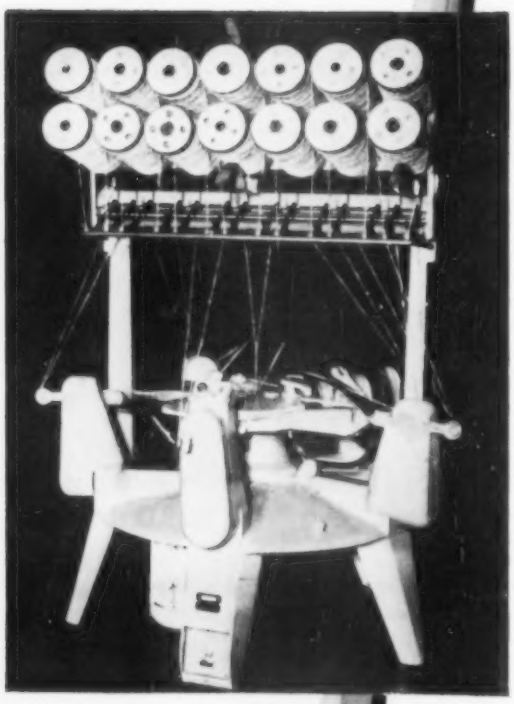
- Acceptance of new materials standards. It is one of the toughest problems that will be met, and there are no easy solutions. The old standards always seem good enough—and it takes forceful selling to overcome this built-in inertia.
- Friction between purchasing departments and materials engineering. This arises because of overlapping activities. Purchasing people usually feel they have exclusive prerogative to deal with vendors. It will be necessary to develop a working relationship by showing them how the materials section can free them from spending time with vendors on matters purchasing is not equipped to handle.
- Delay in getting to the problem. Often the materials engineer is not called in early enough; instead of solving the problem properly, he performs a post-mortem. If the departments being serviced are shown the advantages of consultation early in the problem, they will learn to respond more quickly.
- The key to gaining group acceptance is confidence; best way to establish it is by quick, accurate solutions to problems. Some people may never learn to use the service because of their unwillingness to accept help from others. But acceptance will be hastened by: providing good service; setting a deadline on each problem and sticking to it; finding out what the person presenting the problem really needs and trying to satisfy him; and avoiding a blatant show of your knowledge. Simply ask questions and make suggestions—don't argue.
- A descriptive booklet will help define functions of the group and explain how it works. Some departments will be unfamiliar with the purpose of a materials engineering section. The booklet should tell what the group does and sell its importance.
- A monthly materials bulletin is a useful sales tool too. It can run from two to four pages. In short, easily read paragraphs it should describe new materials, give news of projects under development, and list materials specifications issued during the month. Besides finding the summaries valuable, engineers will be reminded that the materials engineering department is alert—and ready to help. ■

TRENDS in appearance

Kitchen range, its grill at eye level, is from General Electric Ltd. design center.

Typewriter designed by Norman James for Byron Business Machines Ltd.

Design-award telephone by Allen Bowden (top photo) was engineered by Siemens Edison Swan Ltd.; replaces older standard euipment.



Textile plaiting machine was tidied up by putting motor control gear in one of the legs.

design..

IN BRITAIN

Municipal councils get financial aid from government with street lighting if equipment of approved designs (above, by Richard Stevens for Thorn Electrical Industries, Ltd) is used . . . instead of more florid types..

Ohmmeter by Fairey Aviation Co. uses selenium photocell as power source.

Diesel-hydraulic locomotive is by J. P. McCrum and Mischa Black for Western Region of British Railways.

"Britain simply does not invest enough money in industrial design." That's what the man heading the industrial design team of one of England's giant electrical groups bluntly told PRODUCT ENGINEERING's London correspondent. And an educational authority close to the design field declared that it is "by no means universally accepted" that a person trained jointly in technical and aesthetic aspects of design is necessary to the development of a product.

Still another authority commented that only very recently has British industry ceased to believe that "when a product is selling well there is no need to bother much about appearance" and "if it is not selling well there are not sufficient funds to improve it."

Neglect of product appearance has resulted in public apathy to design quality, creating another part of a vicious circle and another barrier to change. The crippling purchase tax imposed on many British consumer goods, a result of the economic burdens resulting from World War II, has had at least as important an effect on buying habits. All forms of decoration were severely restricted; and ignored were possibilities of enlisting good industrial design to wed properly functionalism and appearance. Instead, when an industrial designer was called in at all, it was to wrap an envelope around an already developed mechanism.

Emphasis on quality raised English engineering standards, but did nothing to overcome the reputation many of the resulting products have obtained in overseas markets for a severe, heavy, old-fashioned look.

Not all British industries face revamping their product-development practices. Some of the largest companies, particularly in the electrical and automotive fields, already have well-integrated staffs of engineers and industrial designers.

The serious recognition of industrial design principles in Britain dates back only to 1945 when pressure to re-establish her export markets led the Board of Trade to appoint a Council of Industrial Design. With a grant of $600,000 a year, Britain became the only European country to subsidize the art.

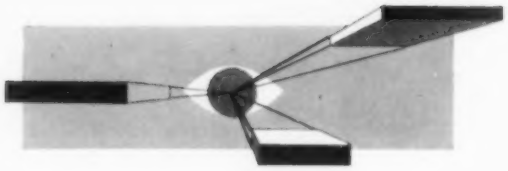
The council's main job is liaison between industry and designers, as well as retail trades. Its "Record of Designers" lists experience, skills, ability and versatility of the country's 2500 design personnel. About half of Britain's designers are engaged on a consultant basis, but present tendency is to recruit full-time personnel.

An example of how industrial design is integrated into the over-all product-development program of a typical large English concern is provided by the design advisory service operated by Associated Electrical Industries, Ltd. Its task is to assist all engineering departments in all divisions with problems of aesthetics. Improvements in the design of transformers (see cover) and air-blast switchgear made by Metropolitan-Vickers Ltd. are among this advisory service's contributions.

All of Associated's engineers know concepts of good appearance design and are encouraged to use models and colored drawings. This training develops sympathy for aspirations of the industrial designer.

There are a number of indications that the design situation in Britain is improving.

Fewer manufacturers seek help from the council only when their design has run into difficulties. More firms are recruiting full-time industrial designers. There is no longer any difficulty in placing pupils from the five colleges which provide industrial design courses. The British Institute of Mechanical Engineers has recently approved an industrial design guide for the use of their members. Most important, the Council for Industrial Design points out, the public's awareness of good design is clearly growing.



POINTS

THE QUESTION:

Must We Compete With Moscow in the Education Race?

DR. R. GOHEEN
President
Princeton University

"If one intends to confront squarely . . .

the current crisis in education he must first recognize that we are wrestling with the needs of education in and for a democratic republic. This means that anything we may seek to do for American education must be considered as relating to the total nature of our society—including the ability of our society to cultivate the individual person.

"The average Soviet high school graduate receives more than five times the amount of science and mathematics required for admission to many front-rank American universities. This is a matter of very serious consequence. It should rightly bestir us to look to our own requirements and strengthen our educational performance wherever it fails of our needs. It will be to our peril, however, if we let the vigorous rise of Soviet science and technology prescribe the curricula of our schools and dictate their aims.

"As there is a yawning abyss between the totalitarian and democratic ways of life, so are the educational requirements of the two disparate in very fundamental respects. Our requirements, let's face it, are for a much more difficult and complex kind of balance.

"Too often these days the pressures and needs of the moment give a platform to the mistaken advocates of science as a super-creed, 'magical and mysterious as it is all-powerful.' The result is to confuse techniques, gadgets, and gimmickry with the aims and achievements of basic science and to demand almost immediate substitution of training and techniques for genuine education.

Improved chances for study and research must be opened to those minds capable of scientific excellence, but at the same time let us hold to a wholeness of view—not to a limited, materialistic point of view, stemming more from the gnawing fear of possible Soviet superiority than from an abiding interest in preserving and strengthening our educational ideals."

NORMAN COUSINS
Editor
Saturday Review

"If our only reason . . .

for bolstering American education is that we do not wish to be outpointed by the Soviet in a cold war or even a hot one, then, paradoxically, we may lose to the Soviet on the education front even as we do a disservice to the cause of education itself. I say this because our program will then reflect a misinterpretation of the nature of the crisis confronting us. We are apt to emphasize and indeed concentrate on turning out countless thousands of scientists in the thought that this is the primary challenge confronting American education.

"Certainly we have to do a better job in science if we are to hold our own in the world. But this is only one aspect of the problem before us. For it will not be enough to develop the techniques that can make superbombs and super-missiles. It will not be enough because there is an even more serious problem in the control of these weapons. Somehow we will have to develop new techniques in human engineering—techniques and knowledge that will enable us to deal effectively with the problems created by a scientific and technological age. We have to develop the kind of world view that will enable America to earn and keep the support of the large majority of the world's peoples. These relationships have at least as much to do with American security as the size of our explosives, the speed of our missiles, or the number of our satellites.

"We need wisdom even more than we need inventions. We need an understanding of the problems involved in the operation of a world society. We need to comprehend the meaning of the term 'world law' and what is involved in putting it to work. In short, we need education for survival. And the problem of human survival requires a somewhat larger context than the cold war alone."

OF VIEW

"It would be foolish self-delusion . . .

to deny that in the production of trained brainpower, the United States is in competition with the Soviet Union. But it would be equally self-destructive for a democracy to take the narrow and materialistic course of diverting all its best talents into scientific and technical studies. We must produce more scientists and engineers, but we cannot neglect our political, cultural and spiritual growth. We must continue to develop our heritage in the diplomatic and political and social sciences which produce the informed and well-rounded citizens on whom effective democracy is based.

"There are three compelling reasons for increasing America's supply of scientists and engineers: first, to meet the demands of the domestic economy; second, to maintain our military effectiveness; and third, to sustain our policy of foreign assistance.

"The United States should not be drawn into the kind of educational race with the Soviet Union that seeks to match scientist for scientist, engineer for engineer, and technician for technician. For national defense, the greatest strength for the United States lies in the integrated resources of ourselves and the nations of the free world."

DR. H. L. BEVIS
Chairman—
President's Committee
on Scientists and Engineers

"The future of this nation . . .

no longer depends upon the size of its population or the richness of its natural resources. It depends upon education. Our military strength is based upon scientific weaponry, not masses of troops. Our economic strength is based upon a high productivity that derives directly from our laboratories—especially in the coming days of dwindling fossil fuels and ores.

"It is simply intolerable to be the second-place nation in the modern world when the first-place nation is an aggressive despotism. Once we lose our leadership, we lose our liberty and possibly our very existence. To maintain our position we *must* compete with Russia in the development of the most strategic resources we have, our trained minds.

"Competing with the Soviets does not necessarily mean imitating them. I am confident that we can tremendously increase the rigor, vigor, and integrity of our school systems without introducing totalitarian methods. But we must start by admitting to ourselves that we are steadily falling behind, that we have taken no effective action, and that we have not even drawn effective plans of action.

"Unless we double the proportion of our national income devoted to education at all levels, unless we raise teachers' salaries, unless we remove all the glamorous encouragements to sloth and slackness and restore respect for learning to our homes and communities, America will die of mental inanition."

DR. J. R. DUNNING
Dean of Engineering
Columbia University

"Even if there were no Soviet Union . . .

in existence, we should constantly seek to strengthen our schools because education is one of the important means whereby the well-being prosperity, freedom, and happiness of people are safeguarded and increased. While we are, in a sense, competing now with Soviet education, it is important to recognize that Soviet practices in education are not generally suited to American objectives. Soviet education serves a Communist state by creating an indoctrinated citizenry and a political elite which controls opinion.

"The proper aim for education in the United States is entirely different. We seek the development of each individual. We seek to develop leadership and high talent from all parts of the whole society.

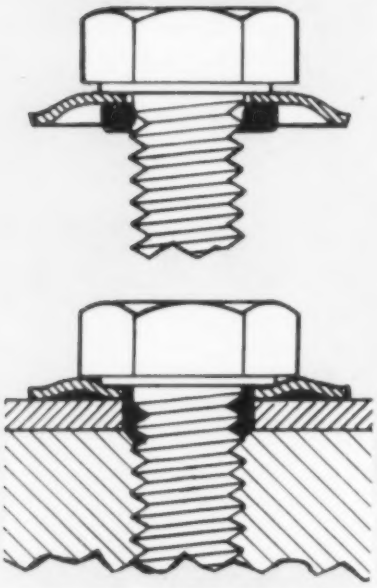
"Thus the challenge before American education is not merely a matter of competition with Soviet science or with the Soviet educational system. The real challenge is for American education to help the American people fulfill the great potential of their own highest ideals."

DR. L. V. GINGER
President
National Education Assoc.
of the United States

SIGNIFICANT PARTS

Multi-contact, full fillet, spheroid bevel and spur . . . gears are capable of operation in either direction and all gears of same part number are interchangeable. Gears need not be matched or timed. Backlash is said to be closely controllable and thrust loads are minimum. A range of 50 sizes of industrial spheroid bevel gear sets are made in ratios of 1:1, 2:1, 3:1, 3:2, 4:3. Prices are competitive with case-hardened and ground bevel gears of comparable quality. Class A (industrial) gears available for 2-3 wk delivery, class AA (precision applications), 5-6 wk. **American Transmission Corp., 575 Bloomfield Ave., Verona, N. J.**

Circle 11, Reader Service Card



Domed sealing washer . . . has a measured amount of PVC-base compound on underside. When pressure is applied, dome of the washer compresses, forcing sealant to seal space between clearance hole and fastener threads, the space between contoured underside of the washer and surface of the fastened material, and upward to seal space between fastener head and washer hole. Withstands temperatures of —100 to 250 F without change. Offered in all standard screw or bolt sizes through ½ in. dia. Now in full production are sizes nos. 10, 12, 14 and ¼, ⅝ and ⅜ in. Delivery is from stock to 2 wk. In production quantities, prices range from $4.50 to $15 per 1,000, depending on material, finish and size. Available in mild steel and high carbon steel, heat-treated, stainless steels, and other metals and finishes. **Bartite Products Corp., 22 Williams St., Everett 49, Mass.**

Circle 12, Reader Service Card

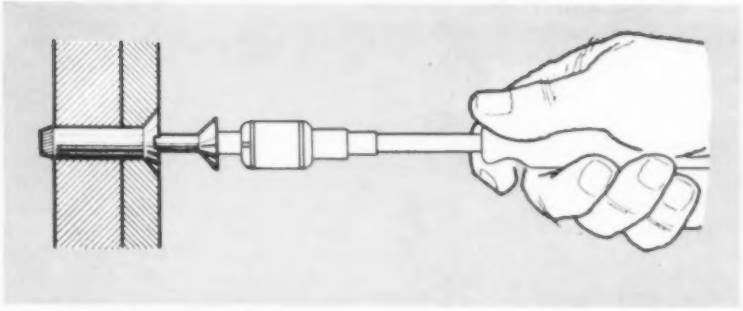
Torque-free bearing assembly . . . is electromagnetically powered and was designed primarily for instrument applications. In laboratory tests, bearings of 0.1875-in. bore have shown starting torque equal to running torque, with both below 25 dyne centimeters. Endurance tests showed no increase in torque after 1000-hr operation. In operation, an electromagnetic device oscillates the outer ring of the supporting bearing, cancelling out the friction torque that resists rotation of the supported member. Bearings are presently available for demonstration purposes. Units to accommodate shafts of 0.1875 in. dia may be purchased for $125 each, FOB Danbury; about 1 mo delivery. **Barden Corp., Danbury, Conn.**

Circle 13, Reader Service Card

Controlled shaft rotation . . . in accurately positioned 2° increments occurs when a pulse of dc voltage is applied across terminals of this electromechanical device. Stepping capacity is said to be 60 steps per second, unlimited in either direction. Torque to 14 oz-in. is possible. Input power requirement is 1 amp at 28 v, which can be applied for as short as 10 millisec per step of output. Mechanism consists of a gear wheel rotated by two solenoid-actuated ratchet pawls. Between impulses, mechanism is locked in shaft positions by a spring-loaded detent. A potentiometer may be incorporated into housing for a divided voltage output proportional to shaft position. Used for dc pulse-to-analog shaft positioning in computers, sequence switching, algebraic counting and remote shaft positioning. Available for 30-45 day delivery. **G. M. Giannini & Co., Inc., 918 E. Green St., Pasadena 1, Calif.**

Circle 14, Reader Service Card

MATERIALS · EQUIPMENT



Reusable blind fastener . . .

can be inserted, tightened and later removed from one side of a panel, bulkhead or sheet metal assembly with an inexpensive attachment to a power tool. Installation of up to 35 assemblies per min is said possible. Three-piece, preassembled unit consists of outer sleeve and expandable nut with a core bolt running through the two. Shear values range from 95,000 psi up, depending on material. Fasteners are offered in titanium, heat-resistant stainless and high-strength alloy steels. Present sizes range from $\frac{3}{16}$ to $\frac{1}{2}$ in. dia. Bolt extends use of blind fasteners to assemblies that have to be dismantled periodically. Price and delivery information not available. **Standard Pressed Steel Co., Jenkintown, Penna.**

Circle 15, Reader Service Card

One-dip conversion coating for zinc . . .

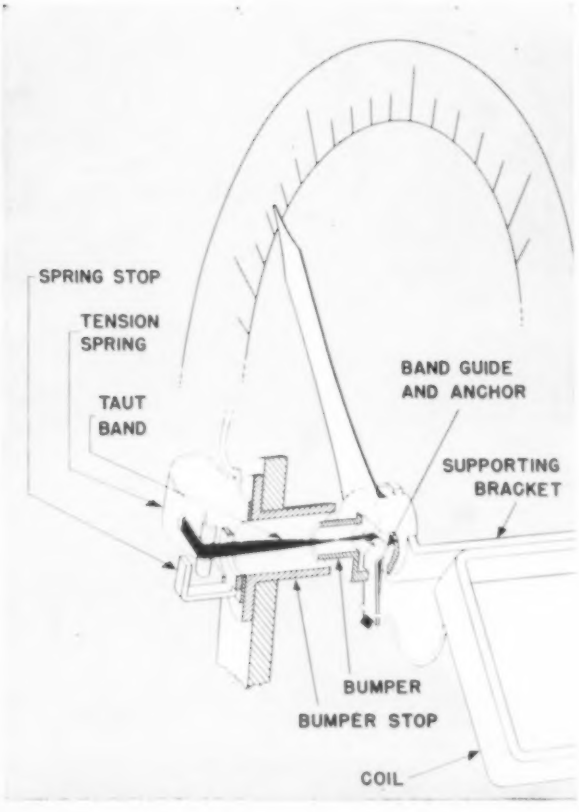
electroplated surfaces or die castings gives clean, blue-bright passive surface that forms excellent bond base for paint or lacquer. Designated Conmax Z-100 Powder, new coating ingredient is said to be most economical, trouble-free zinc conversion coating process developed so far. Approximate cost of bright-dip solution, based on experience to date, is $1\frac{1}{2}$ cents per gal. **Electrochemical Dept., Federated Div., American Smelting and Refining Co., 120 Broadway, New York.**

Circle 16, Reader Service Card

Ceramic withstands heat shock . . .

such as water quenching from 2200 F. Its ability to withstand rapid temperature changes is due to a zero thermal expansion over a 2400-F temperature range. Parts of the ceramic are now available in production lots and have found use in high-temperature tooling and in high-temperature components. Present size limits allow volume production to 2 in. max OD x 2 in. max length. Fired tolerances as close as 0.005 in. are possible and fired parts can be ground to tolerances as close as 0.0001 in. Prices are said to be competitive with normal steatite ceramics. Washers start at about $3 per 1,000. After tooling, delivery is 2-3 wk. **Duramic Products, Inc., 262-72 Mott St., New York 12.**

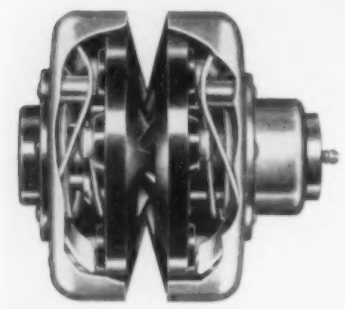
Circle 17, Reader Service Card



Taut band suspension . . .

of moving instrument elements eliminates pivots and bearings and is free from rolling or sliding friction, making possible production of electrical measuring instruments that withstand vibration and shock without affecting accuracy. System is now being used in circular-scale 250° switchboard instruments that offer full-scale deflection with current as low as 50 microamp. In operation, hair-like metal bands under tension support the moving element, carry current to the coil, and supply restoring torque. Instruments, which meet or exceed requirements of ASA Specification C39.1 for indicating instruments, include dc ammeters, milliammeters, and microammeters, voltmeters and millivoltmeters, frequency meters with transducers and ac voltmeters of the rectifier type. Delivery on standard units is about 8-14 wk. Prices competitive with comparable instruments. **Westinghouse Electric Corp., P.O. Box 2099, Pittsburgh 30.**

Circle 18, Reader Service Card



Variable-speed pulley . . .

maintains a constant speed ratio over a wide range of load variation. Pulley employs a cam and cam follower assembly that automatically regulates belt tension to exact requirements of load. Pulley speed is, therefore, independent of load and load variations. Each of two driving disks contains its own cam and cam follower assembly, providing double cam control. Springs are used only to keep driving disks in contact with belt. Pulleys are said to be smaller than comparable units, easily installed and to have replaceable driving disk assemblies. Available in sizes from 0.5 to 5 hp in ratios of 2.5:1 (single pulley) and 6.25:1 (double pulley). **Lovejoy Flexible Coupling Co., 4947-H W. Lake St., Chicago 44.**

Circle 19, Reader Service Card

Subminiature rotary switch . . .

measures ¼ in. dia and weighs ¼ oz. Phenolics are filled with non-organic fibers capable of withstanding high temperatures. Switch contacts are silver alloy. Wipers are rhodium-plated beryllium copper. Now available are 16 shorting and seven non-has O-ring panel seal and two O-ring shaft seals. Space between O-rings on shaft is filled with silicone grease. Unit extends shorting switching arrangements. Switch ⅞ in. behind panel. Rated for operation in temperatures to 257 F. Contacts are rated 1 amp at 250 v dc resistive and 350 ma at 100 v dc. inductive. Contact resistance is less than 0.008 ohm. **Daven Co., Livingston, N. J.**

Circle 20, Reader Service Card

Subminiature neon lamps . . .

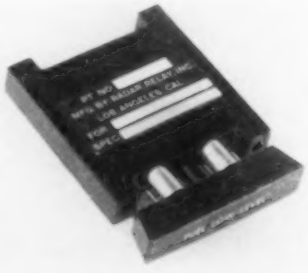
produce over 20 times as much light as previous units. Increased light output is the result of an improved electrode structure and gas content. Lamps have formed tips. High intensity lamps consume ¼ w power with a 2 milliamp current. They produce enough light to serve panel light requirements even in areas where high ambient light levels impair visibility. Operating life varies from 5000 to over 25,000 hr for different models. Lamps measure ¼ x 1 in. long. Midget flange bases are interchangeable in many assemblies and sockets with NE2C, NE2D, NE2E and NE2R and incandescent lamps nos. 327, 328, 330, 331 and 338. Said to be competitively priced in production quantities. **Circon Component Corp., Santa Barbara Municipal Airport, Goleta, Calif.**

Circle 21, Reader Service Card

Stock Teflon rods, tubes . . .

in large diameters are now available free from cracks and fissures. Sizes for both molded rod and tubing range up to 15 in. OD; lengths up to 12 in. for 6 in. OD and lower and 6 in. lengths for larger sizes. Properties are said to include high and uniform density, freedom from stresses, closely controlled dimensions, white color and exceptional concentricity of tubing. This results in protection against defects in machined parts, especially electronic components. Material is sold by the foot, but price translates into $8 to $11 per lb in production quantities. **Chemplast, Inc., 3 Central Ave., East Newark, N. J.**

Circle 22, Reader Service Card



Lighted push-bar switch . . .

is held in position magnetically when depressed to de-energize lighted lamps. Bar returns to original position by spring action when circuit is de-energized. Magnetic hold-in provision may be over-ridden manually. Unit may also be used to energize lamps when switch bar is depressed, providing reset safety features to insure that unit will return to original position. Nomenclature, visible only when lamps are energized, may be incorporated in any of several different styles and colors on bar face. Two lamps can be removed from front of unit. Complete panels of lighted strips may be formed and extinguished selectively. **Radar Relay, Inc., 2120 Pontius Ave., Los Angeles 25.**

Circle 23, Reader Service Card

Thermal relay . . .

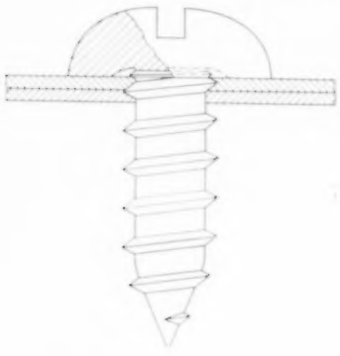
is a one-time-operating, single-pole unit with hermetic seal. When electric signal is triggered, firing effects release of constrained contact, which closes on a fixed contact point. Circuit is then permanently closed. Designed for missile operation. **Hughes Products, International Airport Station, Los Angeles 45.**

Circle 24, Reader Service Card

6-digit electric counter . . .

is rated at 1000 counts per min, but is said to operate reliably at higher speeds with electronic actuation. Count life is reported to be 200 million. Built-in silicone diode full wave bridge rectifier with capacitor makes possible operation through all ac voltages to 230 with 25, 40 and 60 cps frequencies. Available with knob or key reset. Die-cast aluminum housing protects against dust. Conduit opening with separate wiring compartment permits wiring without breaking dustproof enclosure seal. Approximate dimensions are 5⅝ x 3¼ x 4⅜ in. high. **Production Instruments Div., General Controls Co., 8072 McCormick Blvd., Skokie, Ill.**

Circle 25, Reader Service Card



Self-tapping screw . . .

for use with thin-gage metal sheets is threaded to the head with last thread terminating in annular orifice in contact face of head itself. Screws, which are said to hold securely without spinning or slipping, are available in types A and Z in production quantities in noncountersunk heads. **Parker-Kalon Div., General American Transportation Corp., Clifton, N. J.**

Circle 26, Reader Service Card

Prefab tubing assemblies . . .

are said to reduce costs, have good storage life, and retain form and shape. Service consists of cutting, flaring, prebending and applying fittings to specially processed nylon tubing. The tubing is a flexible polyamide which can be positioned in final assembly, for hydraulic or pneumatic, fuel, chemical, beverage or lubricating lines. Available in $\frac{1}{4}$, $\frac{5}{16}$, $\frac{1}{2}$, $\frac{5}{8}$ and $\frac{3}{4}$ in. OD and in short-time burst pressure ratings of 1000 and 2500 psi. **Polymer Corp. of Penna., 2140 Fairmont Ave., Reading, Penna.**

Circle 27, Reader Service Card

Extruded jacketing tubing . . .

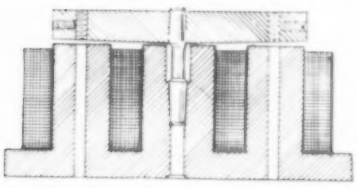
for coaxial, umbilical and other cables is made from a PVC-base material. Reported to have from 11 to 31 times the abrasion resistance of neoprene at various test cycles and, in actual use, is considerably lighter than neoprene. Exposure is said to increase its tensile strength. Remains flexible at temperatures below —100 F. Available in red and black, from $\frac{1}{4}$ to $1\frac{1}{2}$ in. ID. **Borden Chemical Co., Resinite Dept., 350 Madison Ave., New York 17.**

Circle 28, Reader Service Card

Miniature servomotor . . .

is a 60-cps continuous-duty unit in a size 11 frame. Based on a simplified stator and a bobbin-wound coil, the same design, it is anticipated, can be made in sizes down to 0.3 in. dia. Reaches full speed of 1450 rpm in 4/1000 sec. Said to have exceptional internal damping, torque of 0.35 oz-in. at max power output of 0.18 w, and resistance to shock. Operates in ambient temperatures to 400 F. **Dynamic Instrument Corp., 59 New York Ave., Westbury, N. Y.**

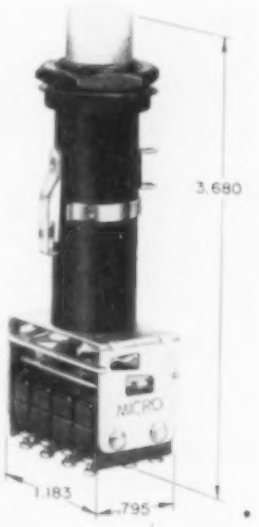
Circle 29, Reader Service Card



Torque motor construction . . .

incorporates a flexure pivot and restoring spring to eliminate mechanical hysteresis or zero shift due to slippage or creep. Spring is a cantilever beam with tapered ends that fits into correspondingly tapered sockets in stationary and moving members of unit. Total hysteresis is said to be held to less than one-half of 1%, and lateral accelerations to have no appreciable effect upon performance. Also, calibration is said to be virtually unaffected by proximity to magnetic materials, because of absence of permanent magnet material and confinement of flux fields. Motors are offered in three standard models, each with output force of 4, 7 or 10 lb, input of 1, 3 or 5 w, and weighing 4, 7 or 10 oz, respectively. All are applicable to wet or dry coil operation. **Graves Mfg. Co., 5968 W. Washington Blvd., Culver City, Calif.**

Circle 30, Reader Service Card



Lighted pushbutton switches . . .

include alternate-action unit and magnetically held units rated 5 amp at 125 or 250 v ac. Magnetically held switch employs a dc holding coil. When button is depressed, switch remains actuated if holding coil is energized. If not, switch functions a momentary pushbutton. Coil serves only to hold switch in operated position until current is interrupted. May be electrically released from any remote source. A bailing circuit allows several switches to operate in one-by-one sequence. Each switch pushed automatically releases any other previously actuated. Switches are offered with 2, 3 or 4 PDT contact arrangements. Translucent plastic buttons are available in various colors and shapes. **Micro Switch, Freeport, Ill.**

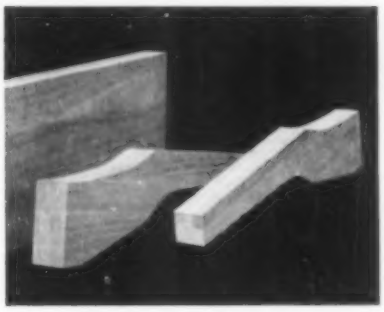
Circle 31, Reader Service Card

Variable-speed mechanism . . .

employs a movable ring, held between a driving disk and a driven drum, which can be controlled or repositioned by a force of less than 0.02 oz as output-shaft load varies from 0 to 2 oz-in. Output-shaft speeds of 0 to 2.75 times input speed are possible. Device can be used as an integrator or variable-speed drive for instrumentation and control applications including chart drives, BTU meters, rate generators, servomechanisms, computers, tachometers and telemetering systems. **Mechanical Components Dept., American Meter Co., Box 306, Garland, Tex.**

Circle 32, Reader Service Card

WHAT'S YOUR WOOD PROBLEM?



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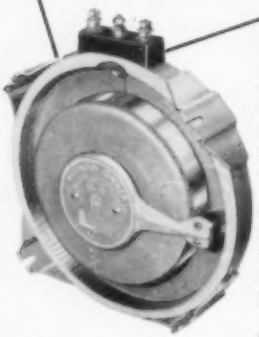
Gibsiloy **contacts**

eliminate "squeal" and welding in Ward Leonard dimmer control



Ward Leonard 6.6 KW 'Radiastat' dimmer control

Contact "squeal" and welding have been eliminated on the "Radiastat*" dimmer control because the manufacturer, Ward Leonard Electric Co., switched to Gibsiloy C-5 silver-graphite electrical contacts.

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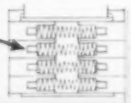
Similar Gibson experience in manufacture of Gibsiloy C-5 silver-graphite contacts approved by Ward Leonard for the "Radiastat" can solve your electrical contact problems. Complete data is available on all Gibsiloys made of silver, tungsten, copper, nickel, palladium and other materials to suit your need.

C-5 silver-graphite contact brush



See our catalog in Sweet's Product Design File or write for Gibson Catalog C-520

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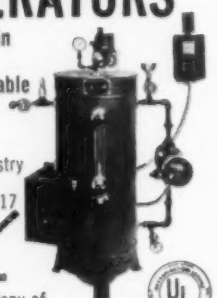

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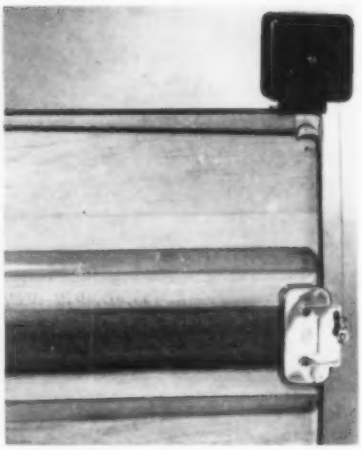

Counter balance attachment . . .

holds a straight edge firmly on a parallel ruling unit at any fixed position, at board angles from near-horizontal to full vertical. Two assemblies are required to support weight of straight edge. Each assembly consists of a constant tension device that mounts at top edge of drawing board and a metal hook-bracket for mounting on straight edge. Pull-strengths of 11, 14 and 17 oz are offered. A chart is available to determine units required. **Frederick Post Co., Reader Service Div., P. O. Box 803, Chicago 90.**

Circle 33, Reader Service Card

Standard control quadrant . . .

providing an infite number of settings with positive holding at any position is available in 54 combinations. Units are designed for loads to 250 in-lb applied to driven member. Adaptability is offered by two basic quadrants, several handles, output lever and pulley configurations and various mounting arrangements. Mounting tabs can be in left or right positions or removed for side mounting. **Reid Metal Products, Inc., 2021 N. Lincoln St., Burbank, Calif.**

Circle 34, Reader Service Card

Microminiature switch . . .

measures 0.5 x 0.35 x 0.2 in. and weighs 1/28 oz. Electrically rated 5 amp at 250 v ac and 30 v dc. Case, cover and plunger are plastic. Contacts are silver and spring is beryllium copper. Designed for mounting through two 0.085-in. dia holes spaced on 0.188 center. Contact arrangement is SPDT. Operating force is 6 oz max; release force 1 oz min. **Micro Switch, Freeport, Ill.**

Circle 35, Reader Service Card

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San Francisco 4 . . . W. C. Woolston, 68 Post St., Douglas 2-4600

NEW LITERATURE

Man, Metals and Modern Magic

J. GORDON PARR, Associate Professor of Metallurgy, University of Alberta. Published by American Society for Metals, 7301 Euclid Ave., Cleveland 3. 5½ x 7¾, 238 pp, $2.95.

A history of the role of metals in building our society should make an exciting book, and when published by one of the principal metallurgical societies it could be a significant contribution. This is particularly true when the work is written in a style and at a technical level comprehensible and enjoyable to engineers and laymen alike. Yet, Mr. Parr's study is not entirely successful.

Curiously enough, the influence of metals on everyday life throughout "metallurgical ancient history" is well detailed—but in those early times, materials other than metal ones filled the bulk of man's structural needs. Then, in the latter half of *Man, Metals and Modern Magic*, when Mr. Parr is concerned with the last hundred years of metal-producing and metalworking history, he devotes most of his pages to detailed descriptions of existing processes, materials and current research activities. His discussion of Bessemer and his contemporaries indicates how exciting Mr. Parr could have made a study of the myriad ways our lives are shaped by our Metal Age environment.—JK

Marketing New Products

DOUGLAS BANNING, McGraw-Hill Book Co., 330 W 42nd St., New York 36. 6¼x9¼, 308 pp. $6.50.

This book is primarily concerned with the marketing problems of small business and can be divided into three sections devoted to merchandising, advertising, and general management activities involved in introducing new products. Should prove a useful source of background to those engaged in those stages of new product development prior to actual marketing.

Symbiotic Interaction Between Science and Engineering

The paper is based on the dictionary definition of symbiosis: the mutually advantageous association of two dissimilar organisms or groups. The functions of scientists and engineers are separately discussed and then the interplay of their activities examined. The following indicates the author's very rewarding approach, ". . . the raw material supplied by science plays the same role for the engineer as do words for the poet. He combines them into a new unity with a content far transcending that of the individual building blocks."

Abstracted from "Symbiotic Interaction Between Science and Engineering," by Gerhart Groetzinger; Rias, Inc., SAE paper 54A, 485 Lexington Ave., New York 17.

MINIATURE INDUSTRIAL CLUTCHES AND BRAKES – Catalog 957 A, 4 pp. Describes performance, specifications and dimensional characteristics. Autotronics, Inc., Dept. 16, Rt. 1, Florissant, Mo.

Circle 1, Reader Service Card

AIR AND OIL CYLINDERS–Bulletins 107 and 108, 12 pp. each. Provide engineering data on heavy-duty air (for 200-psi operation) and oil (for 1000-psi operation) service. Construction is explained, supplemented by a cutaway drawing. Gives dimensional data, with drawings, installation and ordering information for various models. Ortman-Miller Machine Co., Inc., 15 143rd St., Hammond, Ind.

Circle 2, Reader Service Card

SCIENTIFIC RESEARCH–Brochure, 24 pp. Summarizes projects, facilities, services and capabilities in the field of scientific research and engineering, development and testing keyed to industrial demands. Avco Mfg. Corp., Research and Advanced Development Div., 20 S. Union St., Lawrence, Mass.

Circle 3, Reader Service Card

SERVICES AND FACILITIES–Booklet, 8 pp. Describes the services extending from product design engineering and development to production of finished parts, components or products. It lists facilities for cutting and forming metals and materials. Dodge Steel Co., 6501 State Rd., Philadelphia 35.

Circle 4, Reader Service Card

REINFORCED FILMS, PAPERS, FOILS–Catalog, 15 pp. Contains samples of 15 glass and synthetic fiber-reinforced products, together with data on materials used, properties and suggested applications. Facile Corp., 185 Sixth Ave., Paterson 4, N. J.

Circle 5, Reader Service Card

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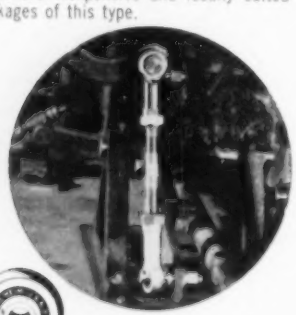
Used wherever motion is to be transmitted at varying angles

Inherent misalignment in the shuttle motion of the label loom made by Fletcher Works, Inc. is shown in this close-up. Heim Unibal Rod Ends are inexpensive and ideally suited for linkages of this type.



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Publisher's Postscript...

How FAST will we grow —and what INDUSTRIES will grow fastest?

Every progressive engineer wants to keep informed about the trends that might affect national growth. He is particularly interested in year-to-year growth of the NATIONAL PRODUCT because it reflects the public acceptance of his ideas and his labors. His designs help create bigger markets . . . contribute much toward the national economy.

In the June 16 R&D issue, we mentioned on this page, and made available to all *Product Engineering* readers, a copy of "BUSINESS PLANS." This 16-page report written by the McGraw-Hill Department of Economics on what industry expects to spend in the next three years for product research and development, as well as for expansion of manufacturing facilities.

Now our Department of Economics has issued another report every forward-looking engineer should have. It deals with the future growth potential of our national economy—what we may expect in 1960, in 1965 and in 1975. It's a 24-page report printed in color—illustrated with 17 charts—and it makes two main points about the American Economy between now and 1975: (1) The substantial growth potential of the US economy as a whole, and (2) The extraordinary potentials for growth of a number of individual industries and industrial fields. There's a lot of food for thought, and ideas that will help you in your future planning.

If you'd like a personal copy of this report, just write "AMERICAN ECONOMY" on the Reader Service Card on the facing page, in the space marked "SPECIAL DATA," add your name and address and mail.

If you haven't already requested a copy of "BUSINESS PLANS," mention it also in the same space, and both reports will be mailed to you. —A. H.

74 For Your Information (personal)

Do-It-All Electrical Tester

Here's a voltage tester, continuity tester and flashlight all rolled into one. Cessco Industries calls it Meter-Lite No. 100. As a voltage tester, it can be used on lines rated at 60 to 400 v; as a continuity tester, it checks high-resistance circuits; and, says the manufacturer, it will also: tell whether a power source is ac or dc; test fuses and tube filaments; locate the ground side of any power supply. Price is $3.45 (less batteries).

The truth about tires

Is a "first line" tire really first? Does "skid-proof" mean absolutely nonskid, or just less likely to slip? Until now, it's been anybody's guess. But a new guide issued by the Federal Trade Commission could clear the air. Says FTC:

- Any tire labeled "first line" must indeed be first in the line—the best the producer can make for general use.
- An "original equipment" tire is a tire generally used as original equipment on American-made, current new-model cars. No other tires should carry this designation—and last year's OEM tires must carry last year's date.
- If a ply number is mentioned, it should be the actual number of plies in the tire. Such terms as "8 ply rating," applied to a tire which does not really have that number, are verboten.
- Absolute terms like "skid-proof," "blowout-proof," and "puncture-proof" may not be used "unless the product affords absolute protection under any and all driving conditions."

Couplings—easy does it

Fittings that fit themselves are being made by J. H. Hoskings Co., Cincinnati 23, for do-it-yourselfers. These, of aluminum, are designed to eliminate threading and welding of pipe, as well as the need for bending to get around corners. They're just installed, then tightened in place as shown. They'll soon be available nationally in standard and swivel types, at prices ranging upward from 86¢ each.

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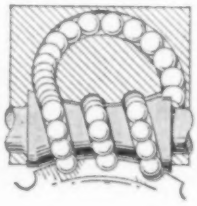
WHY DON'T THEY RESEARCH and DEVELOP...

. . . a plastic squeeze tube or bottle for feeding strained baby food to infants. The container should be able to take moderate heating. It would eliminate much of the mess of spoon feeding.
—J. B. HELM

. . . a plastic coating for house windows, that would filter out infrared light. House or office would be considerably cooler in the summer. The coating should be easily removed in the fall so that sun heating assists the furnace. The plastic could be in the form of a canned spray, or in individual panels for the windowpanes. —R. DEATHERAGE

. . . a ball-type worm drive. It would have all the advantages of low friction loss (serious in worm drives) as well as high gear reduction. Note the need for careful enclosure design for the circulating balls, plus attention to thrust loads on the worm. —C. MCLAUGHLIN



. . . a method of applying thin coats of glass to plastic sheets. The glass would offer good abrasion resistance and permit the use of windshield wipers on light aircraft. Further, a lightweight, abrasion-resistant windshield is a must for practical, roadable aircraft. —D. B. SERGAY

. . . an automobile governor which, when set to a given speed, would give you a "soft" accelerator pedal as long as you are below that speed, and a stiff enough one to be tiring when you get above it. This would overcome the biggest objection to governors, the danger of not having full power in an emergency; at the same time there would be no temptation to drive above the set speed for very long. The adjustment could be either on the instrument board, for drivers who wish to obey speed limits, or locked up, for fleet operators. A hydraulic system seems to offer the best approach. —M. E. PARKER

Have you a pet project but neither the time nor inclination to do the necessary R & D? Product Engineering will welcome (and pay $10 each for) similar ideas based on known scientific principles but lacking an inspired manufacturer

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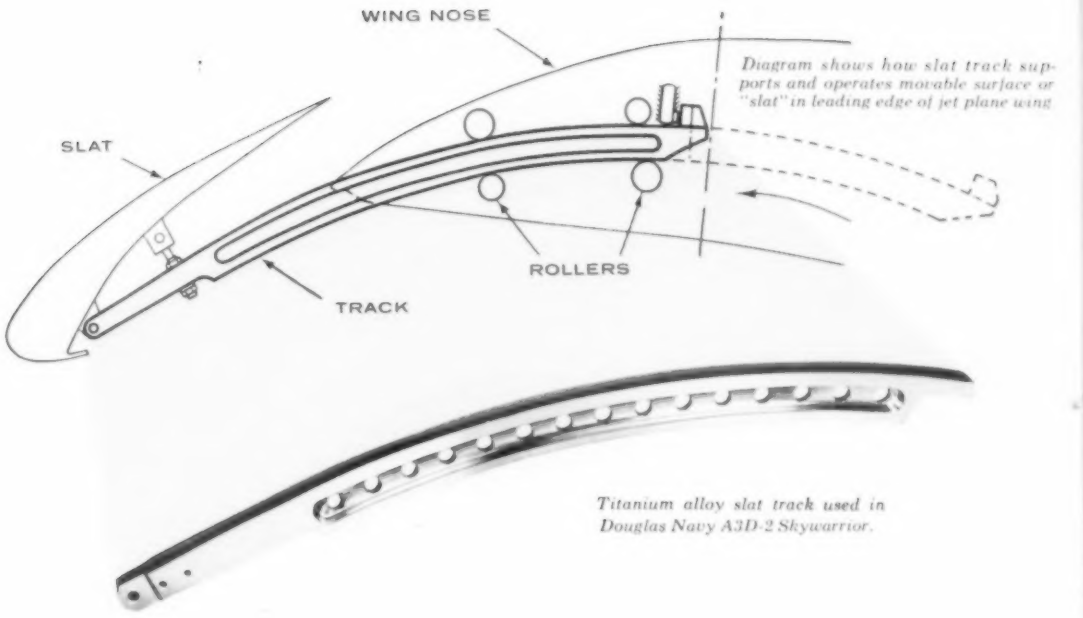

Diagram shows how slat track supports and operates movable surface or "slat" in leading edge of jet plane wing

Titanium alloy slat track used in Douglas Navy A3D-2 Skywarrior.

How Douglas Aircraft used Titanium to gain

44% WEIGHT SAVING...IMPROVED PERFORMANCE

DESIGN REQUIREMENTS AND PROPERTIES OF 6Al-4V TITANIUM		
Property	Douglas Min Design Requirements	Average Test Results (formed and heat treated)
Ultimate Strength, psi	150,000	150-159,000
Yield Strength (0.2% Offset), psi	135,000	136-146,000
Elongation (in 4D), %	8	13
Reduction of Area, %	20	40-43
Rockwell C Hardness (max)	42	—

Douglas engineers faced numerous problems in designing the Douglas A3D-2 Skywarrior slat tracks. Among these were problems of weight reduction, high inertia forces, corrosion and compass deflection.

The application called for a metal with high strength-to-weight ratio, superior corrosion resistance, and non-magnetic properties. Engineering evaluation pointed to heat-treated 6Al-4V titanium alloy as being most suitable for this application.

In subsequent tests, the heat-treated titanium alloy proved out with the following outstanding results:

1. *Weight savings of 44% were obtained, as against any other suitable materials.*
2. *Plating problems encountered with steel tracks were eliminated.*
3. *Titanium's non-magnetic properties minimize compass deviation.*
4. *Repeated impact loads against the stop (20,000 cycles) caused no cracks or failures of any kind.*

Are *you* making full use of titanium and its alloys in designing for lighter weight, improved performance? Our experienced Service Engineering group is ready to assist you now.

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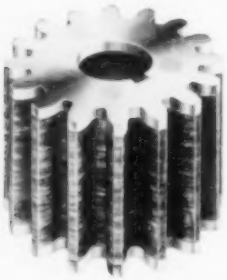

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